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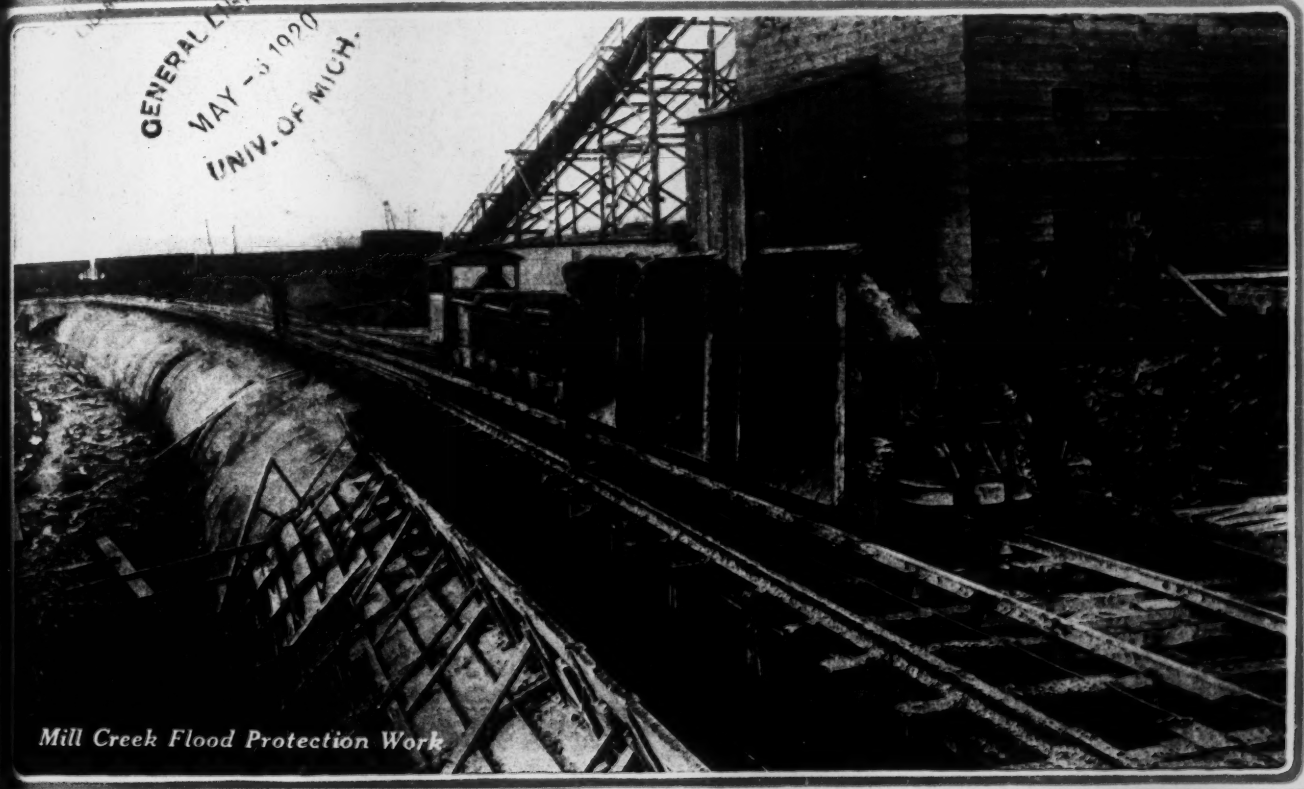

Mill Creek Flood Protection Work

For Contractors

A valuable article by F. J. Herlihy giving detailed information on the construction of temporary trestles for grading operations. Existing construction literature supplies but meagre data on this subject.

Other Articles

Principles Determining Bitumen Content in Bituminous Concrete
By Prof. Roy M. Green

Progress on Mill Creek Flood Prevention Project
By Farley Gannett

Design and Construction of Inverted Siphon of Reinforced Concrete

Freighting with Motor Trucks on Rush Construction Job

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

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Editor

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Chicago Getting Frugal

RECKLESS bond issues got a setback in Chicago April 27, when five municipal improvements calling for an expenditure of $34,500,000 were voted down. Citizens apparently looked at the increased tax bills of the past year before going to the polls. And the women exceeded the men 5 to 4 in their zeal for economy. Probably the average voter did not go farther in his reasoning against the bonds than the tax increase but the analysis of the Chicago Bureau of Public Efficiency is more explicit. In substance it is: (1) The tax levy for bond interest and redemption has more than doubled in five years, increasing from $5,000,000 to $10,259,887. (2) The proposed bonds would have encumbered the bonding power for the next five years. (3) Improvements under way call for $35,000,000 of unexpended authorized bond funds. Still more bonds may be needed to complete some of the projects. If the proposed bonds were authorized it would be necessary to postpone or abandon partially finished work until the city were again within its debt limit. (4) At present prices bonds must sell at 92. (5) Prices are abnormal. Labor and materials are needed for more urgent purposes. (6) The city's finances are thoroughly demoralized. Its budget calls for several million dollars more than its available income. Defeat of the bond issue will restrain further reckless waste and expenditures. In view of this analysis it is not surprising that the bankers recently refused to help out the city with loans for corporate expenses, as they had done a few years ago in a similar emergency. Living within one's income is no less imperative on cities than on individuals in these days, and somehow Chicago will be able to limp along without the additional lights, bridges, parks and convention hall that the people voted down.

Encumbering the Future

CHICAGO'S calling a halt on the authorization of bonds when there is no possibility, physically, of getting the work done within any reasonable period is one of the hopeful signs of the times. The piling of bond issue on bond issue in this country cannot help but bull the material and labor market beyond reason. It has the same psychological, if not actual, effect as that of the over-orders with which manufacturers are finding their books encumbered. Some wise manufacturers are not buying raw materials to fill more than 30 per cent of their booked orders. They know what the maximum possible consumption is and how many cancellations there must be. The authorization of debts for posterity to pay should not be lightly done. We need these particular improvements but before authorizing them we should be sure that something else is not more needed or will not be before the bonds are redeemed.

Society Unity Progresses

BOARDS of all of the founder societies held regular meetings in Chicago on April 19 and material proof of their co-operation, if the middle-west engineer needed any, was accentuated by a "Joint Engineering Societies Dinner" in which was included the Western Society of Engineers. How, not whether, the many societies of the country may co-operate was the topic of conversation despite the adverse vote of the American Society of Civil Engineers against participating in the formation of a comprehensive organization. No definite program was outlined, but Calvin Townley sounded the keynote in the one word "service"—unselfish service to the state and society. If this high ideal is adhered to the framers of more definite aims and objects will have done well.

Contraction in Wood-Block Paving

UNIQUE experiences with wood-block paving in St. Louis, Mo., are reported in the article by W. W. Horner on p. 814 of our issue of April 22. Briefly, on certain streets where the temperatures of summer construction run high, the blocks shrank loose and the pitch fillers melted and floated them up so that the surface of a newly-laid pavement was practically destroyed. The circumstances and the results of the failure are fully explained by Mr. Horner. He also outlines such investigations as the conditions permitted to be made to determine the cause of the peculiar phenomena which occurred. So far as was disclosed, no cause appeared for the extraordinary contraction and warping action exhibited by the blocks. Thoroughly seasoned and impregnated in apparently the manner generally recognized as insuring a non-bleeding and dimensionally stable product, the blocks shrank and curled up like autumn leaves. Without explanation of the block distortion and therefore, without knowledge of the means of remedying the trouble, the problem resolved itself into one of construction methods to meet unusual conditions. It is comforting to observe that successful methods were discovered and that they are comparatively simple and inexpensive. So far, then, as the strange block action as observed in St. Louis and as described by Mr. Horner offers a construction problem to the practical paving engineer that problem may be considered solved. But the problem of accounting for the phenomena of block distortion is more fundamental. It is a problem for the timber preservation expert. His task is one of determining minutia of treatment technique, and of appraising their effects. Time may be required. Meanwhile the paving engineer will record the fact that under certain conditions contraction of wood block pavement may be as serious a destructive agency as expansion has long been considered.

Congress and the Cantonments

NO one who has followed the temper of the Congressional committees who are "investigating" the war will be surprised at the tone of the majority report on cantonment construction. Washington has long since discounted the findings of such committees, remembering that this is Presidential year, and that the first principle of politics is to prove the general incapacity of the opposing party. The unfortunate thing about this particular report is that on the basis of certain obvious evils there has been built up a long chain of damaging charges which are by no means proved and which, if generally accepted, will be bound to lower the public estimation of the profession of engineering and the business of contracting.

In brief, the report charges that the Council of National Defense usurped the prerogatives of the regular governmental organization in the matter of providing camps for the draft army and delegated such power to a group of engineers, architects and contractors, who by means of a vicious form of cost-plus contract permitted certain favored contractors to make inordinate profits in the construction of the camps, at the same time delaying that construction and increasing costs from 40 to 60 per cent, or about $80,000,000. It is the claim of the majority of the committee that by the usual method of competitive bidding the established army bureaus could have completed the camps at lower costs and within the prescribed time.

The assertion of usurpation of power is pure politics and therefore of minor consequence; the gentlemen who make it have doubtless forgotten that they were loud in a demand for a Ministry of Munitions two years ago. Nor is there anything to commend in the suggestion that the Quartermaster Corps or the Corps of Engineers should have proceeded to build the camps by the competitive bid method. The Quartermaster Corps had in its personnel a few engineers who were accustomed to build the very minor structures required for a peace-time army. Its main duty was furnishing supplies to the troops. To add to this tremendous task the responsibility of getting together in three months housing for nearly a million men would have been ridiculous. The Engineers, on the other hand, while quite competent professionally, were pitifully undermanned for their real business, that is, the development of the military engineering end of the war establishment. Their every effort was needed for that. An extraordinary control of the cantonment construction was clearly indicated, though in an ideally prepared army organization the extension of existing facilities should be possible.

As to lump-sum or unit-price competitive bidding, it simply would not have worked. This is the nub of the whole matter. The committee assumes, first, that it would have been possible to have obtained such bids, and, second, that once obtained the work would have been carried to a rapid and economical conclusion. It bases its premises on testimony of a few relatively unimportant contractors who, two and a half years after the event, testified that they would have been glad to bid and would have completed the work much cheaper than it ultimately cost. As the minority report so well points out, "no contractor could go to one of the camps and, without a knowledge of conditions at the site before the work was started or the trials experienced and obstacles overcome by those who actually did the work, make an intelligent estimate of what the job would have cost two and one-half years before." To assume so is merely to forget, as all the "investigating" committees forget, the superiority of hindsight to foresight in the matter of prophecy. With the uncertain conditions in the labor and materials market in the beginning of the war, it would have been rank lunacy for any contractor to make a bid for so large and uncertain a piece of work as a cantonment without protecting himself to the limit. Had such bids been made and accepted, these protective additions, together with extras, would have brought the costs well up to those which were actually incurred.

There remains the indictment of the cost-plus contract. Here the committee is on somewhat surer ground. It would be hardly possible to get together a more complete set of arguments against this method of letting public contracts than is contained in the majority report. Practically all the points to be made are there—the dangers of favoritism, the destruction of the morale of labor which is secure in the knowledge that it can loaf with impunity because the Government is rich and the boss cannot lose, the tendency to waste and the division of authority.

No one who was in Washington in the spring of 1917 or who followed the camp construction that summer has any illusions as to a 100 per cent efficiency in building the cantonments. Wire pulling was just as evident in the scramble for contracts as it was in the selection of sites, though inasmuch as the congressmen themselves were the offenders in the latter, the committee chooses to forget it. At every camp a certain proportion of the labor were flagrant profiteers, intent on giving a minimum of work for a maximum of pay. In the aggregate, waste due to carelessness and to crookedness was tremendous. The shedding of responsibility, in the vernacular, "passing the buck," was just as popular in the camp construction as it was in all the other war activities.

All of this, however, was a part of the general psychology of war. Conditions, admittedly, were not ideal, but they were as good as could have been expected in an imperfect world, especially in that part of it thrust, unprepared, into the midst of a great conflict. That any of the evils were aggravated by the method adopted for camp construction is not shown by the committee's report. Indeed, it is more than likely that all of them would have been present in greater or less degree under any system of contract. The abnormality of building simultaneously in three months and at the beginning of a war sixteen large cities would negative all the records of experience.

In more auspicious times the men who were responsible for the camp construction might adopt different methods. Time reveals many things. They were, however, confronted with an extraordinary situation. They were forced to use their best judgment as to the method of meeting it. Nothing has been advanced to show that that judgment was not as good as was humanly possible, or that results, though imperfect, were any worse than would have been brought about under any other method They have the additional merit of having been successful, however far they fell below perfection. The stupendous character of the task has been lost sight of in its achievement. Because it was done, it is easy to

assume that any one could have done it by other methods. In an ideally regulated future, there ought to be some way of providing that a contractor, taking no risk, does not get one hundred times the pay of an engineer serving in responsible charge as Constructing Quartermaster. There ought to be some method of getting labor to give full service when labor is scarce. Unfortunately it is difficult to work out such social problems in the beginnig of a great war.

One good thing the committee has done. It has brought squarely before the engineering and contracting professions the inherent difficulties of the cost-plus contract as applied to public work. There has been much propaganda lately favoring this system, largely based on some real advantages that it has. This report shows only too clearly that the possibilities of public scandal, the ease with which proper performances can be given an improper appearance, far outweigh such real advantages. In normal times, competition, based on financial outlay and assumed risk, must remain the foundation of public contracts.

Prosperous Systems and Rate Regulation

AT LEAST one point of rather striking similarity between the railroad situation in Canada and that in this country was remarked in these columns April 15. The comparison was drawn between the Canadian Government's apparent unwillingness to grant rate increases sufficient to render losing lines supporting, for fear of too great dividends accruing to the strong Canadian Pacific Railway, and the previous policy of the Interstate Commerce Commission in this country to hold rates so low that many roads were threatened with bankruptcy. There is ground for belief that members of the commission had felt obliged to take this course in order to prevent the earning of huge dividends by certain prosperous systems. Now, the new Transportation Act limiting "excess" earnings by a "take-off" above 6 per cent should tend to alter this policy.

Following the present period of guaranteed earnings, it has been stipulated by Congress that, from Sept. 1, 1920, to March 1, 1922, rates shall be made to produce a net return of 5½ per cent, on aggregate "value," and after that time, a rate of return to be fixed by the Interstate Commerce Commission. An additional one-half of one per cent is to be allowed for unproductive betterments, but one-half of the "excess" above 6 per cent must be paid into the Federal transportation fund. There is reason to believe that this arrangement will result in a more liberal attitude on the part of the commission.

We are now witnessing the instance of a large system going into the market with a $50,000,000 bond issue at 7½ per cent, taking into consideration banker's discount. With the "take-off" set at one-half the excess above 6 per cent, a railroad will have to earn 9 to pay 7½ per cent. In the instance at hand the new expenditure must result in earning an additional net revenue considerably greater than the bond interest rate to justify the investment, since the railroad is in a fair way to earn appreciably more than the allowed 6 per cent and will be subject to the take-off. Were the lines less advantageously located and not likely to earn more than the fixed rate, new expenditures would not have to bring as great an additional net increase with respect to the new investment, since the take-off would not apply. Here again, the levelling process of the Transportation Act promises to have an important effect with respect to new capital in lessening the tendency to starve all of the railroads for the sake of checking big earnings of a few.

Railroad starvation is the direct cause of serious shortage of transportation facilities. Although it was partially the natural result of previous high-handed acts of some railroad managements, we believe that it had its real origin in the fear of permitting too great dividends to a few rich systems regardless of the plight of the average railroad. Under the terms of the new law this objection begins to disappear and there is already to be seen striking evidence of a more liberal attitude on the part of regulative bodies.

Designed Plans for Temporary Trestles

GUESSWORK is perhaps more common in estimating temporary trestle costs and quantities than in computing the values of most other items of a construction plant. This comes largely from a habit born of the time when, in the great bulk of grading operations, timber for rough trestle building was available at inconsiderable prices and often at the price of cutting it from the adjacent forest. Those days have gone. With them has gone also any justification for extravagant practices in building construction trestles. Except in rare instances sawed timber is the only timber now available, and present prices make sawed timber almost precious, even as a material for permanent structures.

These considerations lend importance to the temporary trestle plans and quantity tables on p. 844, prepared by J. F. Herlihy. The data given apply to a wide range of conditions and are published in such form that they may be used directly from the printed page or transferred into a note book for greater convenience. It will be a gross error to assume that those drawings and tabulations represent a degree of refinement in planning construction trestles which goes beyond the practical needs of the contractor.

Timber prices now make necessary designed plans for temporary trestles. As used in most grading operations the structure is buried in the fill. Generally speaking, the salvage under all conditions of use is insignificant. Economy of material is the first result of design. Its even greater advantage is that quantities can be known precisely. This is of great practical importance, first to the estimator in fixing bidding prices, and second to the purchasing agent, who may thus make his mill orders and shipping directions definite and issue them in time to allow for possible delays in delivery.

A collateral advantage of designed plans for construction trestles is that the field superintendent knows exactly the kind of structure which he has to frame and erect and can systematize and standardize the construction procedure so as to minimize time and cost. To the home office is given the reasonable certainty that, however far afield the operations may be, there will be no failure of the structure built, because of faulty design and construction. Finally, there is the fact not to be overlooked that another detail of contracting procedure has been raised above the fog of assumption and guesswork.

Construction Trestle Plans and Quantity Tables

Tabulations Adapted to Wide Range of Requirements Expedite Work of Estimator, Purchasing Agent and Erection Superintendent

By F. J. Herlihy
Winston Bros. Co., General Contractors, Minneapolis, Minn.

QUICK estimates of the cost of temporary trestles may be made by means of the accompanying plans and quantity tables. The data apply to both narrow gage and standard gage structures and to a range of sizes which meets the demands of all ordinary operations. They have been developed from actual construction experience and are in regular use both for estimating costs and for planning grading operations in which trestles are required. There is, in fact, quite as much value, in the data, to the trestle builder in the field as to the estimator and the purchasing agent in the office.

As printed, the drawings and tables contain all the details of the original prints and may be used directly.

The plans, Figs. 1, 2 and 3, and the Tables I, II, III and IV are for trestles varying in height by multiples of 2½ ft. from 5 ft. to 40 ft. for hauling outfits

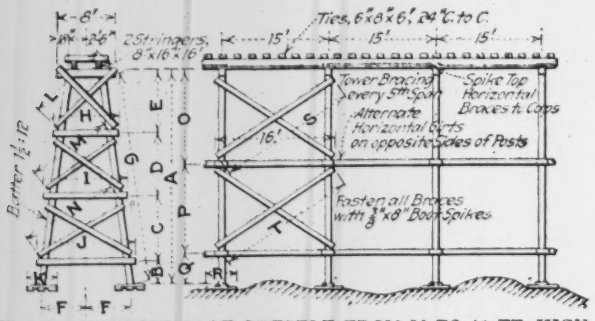


FIG. 1. NARROW GAGE TRESTLE FROM 30 TO 40 FT. HIGH

consisting of 4-cu.yd. cars, dinky locomotives, and 3-ft. gage track.

The plans, Figs. 4, 5 and 6, and the Tables V, VI, VII and VIII, are for trestles of corresponding variations in height for standard gage equipment.

Table IX gives quantities per foot of trestle for both 3-ft. gage and standard gage equipment. It is useful particularly for quick cost estimating.

The data are for framed bents resting on mud sills as these are more economical ordinarily than are driven bents. In places where the foundation material encountered is too soft to give the required bearing for mud sills, either full length pile bents may be driven or short piles may be driven and capped close to the ground, and then framed bents erected on top of the caps. If the latter method is employed the plans and tables shown will still be applicable.

For the trestles shown the bents are designated as one-story, two-story and three-story bents, each set of sway bracing being considered as one story. The plans are so worked out as to use standard sizes and lengths of timber for all trestles. The plan views and details of the tops of bents shown in Figs. 3 and 4 are typical for all trestles and show those details for 4-cu.yd. and standard-gage outfits, respectively. Only fixed dimensions are shown on the plans. Variable dimensions are designated by capital letters and their values are tabulated in Tables I and V.

A minimum height of 5 ft. is taken for trestles, as it is usually more practicable to raise the track than it is to build trestles for fills which are shallower than 5 ft. It is not practicable to construct fills higher than

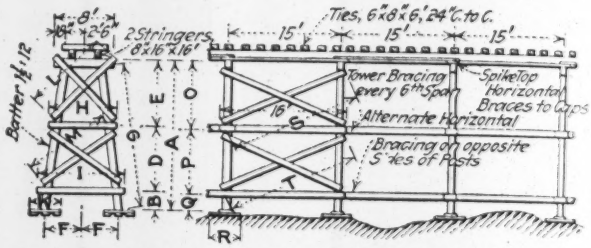


FIG. 2. NARROW GAGE TRESTLES FROM 20 TO 30 FT. HIGH

40 ft. from a single trestle. When higher fills are necessary and conditions will permit, they should be constructed in two or more lifts, depending upon their height, with 40 ft. as the maximum height of the trestle. When the topography is such as to make the construction of high fills in one lift necessary, special trestles designed to suit the conditions should be used.

Tables II, III and IV and VI, VII and VIII show bills of material for one bent, one span and one set of tower diagonals for the different heights of trestles, tabulated for 4 cu.yd. and for standard gage outfits, respectively. For a trestle which falls between the heights designated, all material, except posts, should be ordered for the next higher trestle than the one being considered. The lengths of posts for such trestles can be ascertained by adding to or deducting from the lengths shown for posts of tabulated heights, the difference in height between the bent tabulated and the one considered. The slight error due to the inclination

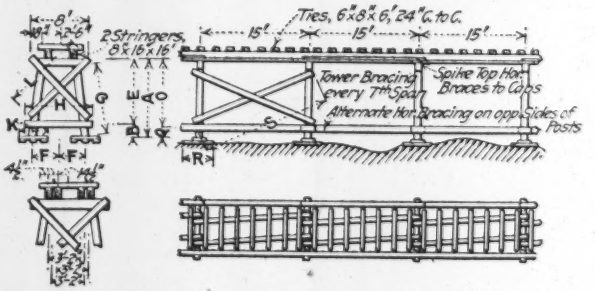


FIG. 3. NARROW GAGE TRESTLES FROM 5 TO 20 FT. HIGH

of the batter posts will be negligible, as extra length is provided in the tabulated lengths to allow for squaring up the ends of the posts in framing them.

The construction shown is that commonly used for ordinary work. In locations where standing timber is available, or where it is cheaper or is expedient, poles or round timber of equivalent strength may be substituted for the square timber.

The 4-cu.yd. outfit trestles have bents composed of two posts, each set on a batter of 1½ in. in 1 ft. with minimum diameters of 6 in. and 8 in. at the tips and

butts respectively, capped with 8 x 12-in. caps, 8 ft. long and securely braced with 3 x 8-in. sway and sash braces. The bents are founded on mud sills of two 3 x 12-in. plank 4 ft. long placed on six pieces of plank of the same dimensions, laid at right angles to the sills directly on the ground to spread the foundation. The floor consists of two 8 x 16-in. stringers 16 ft. long and eight 6 x 8-in. ties 6 ft. long for each span. The stringers are so laid that the longitudinal center line of each rail coincides with the longitudinal center line of the stringer at the center of the span, and the center between each line of stringers on adjoining spans coincides with the center line of each rail at the bents. The trestles are braced longitudinally with continuous lines of 3 x 8-in. girts 16 ft. long and 3 x 8-in. tower diagonals at the intervals shown.

The standard gage outfit trestles have bents composed of four posts each with minimum diameters of 7 in. and 10 in. at the tips and butts, respectively; the inside posts are set plumb and the outside posts are set on a batter of 1½ in. in 1 ft. The posts are capped with 12 x 12-in. caps 12 ft. long and are securely braced with 3 x 8-in. sway and sash braces. The bents are founded on 4 x 12-in. mud sills resting on eight 3 x 12-in. plank 4 ft. long laid directly on the ground. Where the topography is such as to necessitate it, these sills may be cut into short sections. The floor consists of four 8 x 16-in. stringers 16 ft. long and eight 6 x 8-in. ties 8 ft. long for each span. The trestles are braced longitudinally with continuous lines of 4 x 8-in. horizontal girts 16 ft. long and 3 x 8-in. tower diagonals at the intervals shown.

Caps for all trestles are drift bolted to posts with ¾ x 18-in. drift bolts; stringers are drift bolted to caps with ¾ x 20-in. dirft bolts; all bracing is spiked to the posts and caps with ⅜ x 8-in. boat spikes and every

TABLE I. DIMENSIONS IN FEET AND INCHES OF NARROW GAGE TRESTLES SHOWN BY FIGS. 1, 2 and 3

Mark	One-Story Bents							Two-Story Bents					Three-Story Bents				
Height	5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
A	5'-0"	7'-5"	10'-0"	12'-"	15'-0"	17'-6"	20'-0	20'-0	22'-6"	25'-0	27'-6"	30'-0"	30'-0"	32'-6	35'-0"	37'-6"	40'-0"
B	1'-0"	1'-6"	1'-6'	2'-6"	3'-0"	5'-6"	5'-6"	1'-0"	3'-6"	3'-0"	1'-6	4'-0"	1'-6'	1'-6	1'-0"	1'-6"	4'-0"
													9'-6"	12'-0"	10'-0"	10'-0"	10'-0"
D								9'-0"	9'-0"	12'-0"	14'-0"	14'-0"	9'-0"	9'-0"	12'-0"	14'-0	14'-0
E	4'-0"	6'-0"	8'-6"	10'-0"	12'-0"	12'-0"	14'-6"	10'-0"	10'-0"	10'-0"	12'-0"	12'-0"	10'-0	10'-0"	12'-0	12'-0	12'-0
F	3'-0"	3'-3½"	3'-7½"	3'-11½"	4'-3"	4'-6½"	4'-10½"	4'-10½"	5'-2½"	5'-6"	5'-9½"	6'-1½"	6'-1½"	6'-5½"	6'-9"	7'-0½"	7'-4½"
G	4'-0½"	6'-6½"	9'-0½"	11'-7½"	14'-1½"	16'-7½"	19'-1½"	19'-1½"	21'-8"	24'-2½"	26'-8½"	29'-2½"	29'-2½"	31'-9"	34'-3½"	36'-9½"	39'-3½"
H	8'-0"	8'-0"	9'-0"	9'-0"	10'-0"	10'-0"	10'-0"	9'-0"	9'-0"	9'-0"	10'-0"	10'-0"	9'-0"	9'-0"	10'-0"	10'-0"	10'-0"
I								12'-0"	12'-0"	12'-0"	14'-0"	14'-0"	12'-0"	12'-0"	12'-0"	14'-0"	14'-0"
													14'-0"	14'-0"	16'-0"	16'-0"	16'-0"
K	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"
L	12'-0"	12'-0"	12'-0"	12'-0"	14'-0"	14'-0"	16'-0"	12'-0"	12'-0"	12'-0"	14'-0"	14'-0"	12'-0"	12'-0"	14'-0"	14'-0"	14'-0"
M								12'-0"	12'-0"	14'-0"	16'-0"	16'-0"	12'-0"	12'-0"	14'-0"	16'-0"	16'-0"
N													14'-0"	16'-0"	16'-0"	16-0	16-0
O	4'-0"	6'-0"	8'-6"	9'-6"	13'-6"	17'-0"	19'-6"	9'-6"	9'-6"	9'-6"	13'-6"	13'-6"	13'-6	17'-0"	17'-0"	17'-0"	19'-6"
P								9'-0"	9'-0"	13'-0"	13'-0"	13'-0"	13'-0	13'-0	16'-6"	16'-6"	19'-0"
Q	1'-0"	1'-6"	1'-6"	3'-0"	1'-6"	0'-6"	0'-6"	1'-6"	4'-0"	2'-6"	1'-0"	3'-6"	3'-6"	2'-6"	1'-6"	4'-0"	1'-6"
R	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"
S	18'-0"	18'-0"	18'-0"	18'-0"	20'-0"	22'-0"	24'-0"	18'-0"	18'-0"	18'-0"	20'-0"	20'-0"	20'-0"	22'-0"	22'-0"	22'-0"	24'-0"
T								18'-0"	18'-0"	20'-0"	20'-0"	20'-0"	20'-0	20-0	22'-0"	22'-0"	24-0

TABLE II. BILL OF MATERIAL FOR ONE BENT OF NARROW GAGE TRESTLE

Item	Height	One-Story Bents							Two-Story Bents					Three-Story Bents				
		5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
8 x 12 x 8'-0		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3 x 12 x 4'-0		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
3 x 8 x 8'-0		1	1						1	1	1			1	1			
3 x 8 x 9'-0				1	1													
3 x 8 x 10'-0						1	1	1				1	1			1	1	1
3 x 8 x 12'-0		2	2	2	2				5	5	3			5	5	1		
3 x 8 x 14'-0						2	2				2	3	3	3	1	4	3	3
3 x 8 x 16'-0								2				2	2		2	3	5	5
5'-0 posts		2																
7'-0 posts			2															
10'-0 posts				2														
12'-0 posts					2													
15'-0 posts						2												
17'-0 posts							2											
20'-0 posts								2	2									
22'-0 posts										2								
25'-0 posts											2							
27'-0 posts												2						
30'-0 posts													2	2				
32'-0 posts															2			
35'-0 posts																2		
37'-0 posts																	2	
40'-0 posts																		2
¾ x 18 drift		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
⅜ x 8 spike		80	80	80	80	80	80	80	100	100	100	100	100	130	130	130	130	130

TABLE III. BILL OF MATERIAL FOR ONE SPAN OF NARROW GAGE TRESTLE

Item	Height	One-Story Bents							Two-Story Bents					Three-Story Bents				
		5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
8 x 16 x 16'-0		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
6 x 8 x 6'-0		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
3 x 8 x 16'-0		4	4	4	4	4	4	4	6	6	6	6	6	6	6	6	6	6
¾ x 20 drift		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
⅜ x 8 spikes		50	50	50	50	50	50	50	60	60	60	60	60	60	60	60	60	60
⅜ x 9 spikes		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

TABLE IV. BILL OF MATERIAL FOR TOWER DIAGONALS FOR NARROW GAGE TRESTLE

Item	Height	One-Story Bents							Two-Story Bents					Three-Story Bents				
		5'-0"	7'-6"	10'-0	12'-6"	15'-0"	17'-6"	20'-0"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
3 x 8 x 18'-0		4	4	4	4				8	8	4							
3 x 8 x 20'-0						4					4	8	8	8	4			
3 x 8 x 22'-0							4								4	8	8	
3 x 8 x 24'-0								4										8
⅜ x 8 spikes		50	50	50	50	50	50	50	100	100	100	100	100	100	100	100	100	100

second tie is line spiked to the stringers with ⅞ x 9-in. boat spikes. The top girt for all trestles is laid flatwise on top of the cap instead of being spiked to the side of the posts as in permanent trestles so as to provide a walkway around the hauling trains. There is often a difference of opinion as to the intervals between tower spans for trestles and as the tables show quantities for a single tower only, they are applicable no matter how many tower spans are decided upon.

All plans and tables were worked out in such a form as to serve not only the purposes of the estimator and the purchasing agent, but also to be used as finished drawings for the construction men in the field. They were originally drawn and blueprinted on sheets 4¼ x 7¾ in., which are a convenient size to put into loose-leaf binders and carry in the pocket. Table IX was of course made up for the estimator's use exclusively.

In ordering material a profile of the natural ground along the line of the trestle on which the grade line and center lines of bents are shown is the only information necessary. From this information the number of bents of the different heights may be ascertained and the unit quantities for these bents as well as for the other members of the trestle may be read directly from the tabulated quantities.

Usual construction methods are followed in the field. The bents are framed on the ground and raised to their true position, the first two by gin pole. After these two are braced, the others are raised by block and

TABLE V. DIMENSIONS IN FEET AND INCHES OF STANDARD GAGE TRESTLES SHOWN BY FIGS. 4, 5 AND 6

Mark	One-Story Bents					Two-Story Bents						Three-Story Bents			
Height	5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
A	5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
B	1'-0"	2'-6"	1'-0"	1'-0"	1'-0"	1'-6"	4'-0"	2'-6"	2'-0"	1'-0"	3'-6"	1'-6"	2'-6"	1'-6"	2'-0"
C	....											11'-0"	10'-6"	13'-0"	11'-6"
D						7'-0"	7'-0"	11'-0"	14'-0"	12'-6"	12'-6"	11'-0"	10'-6"	14'-0"	12'-6"
E	4'-0"	5'-0"	9'-0"	11'-6"	14'-0"	9'-0"	9'-0"	9'-0"	9'-0"	14'-0"	14'-0"	9'-0"	11'-6"	9'-0"	14'-0"
F	2'-0"	2'-3½"	2'-7½"	2'-11½"	3'-3"	3'-6½"	3'-10½"	4'-2½"	4'-6"	4'-9⅞"	5'-1½"	5'-5½"	5'-9"	6'-0½"	6'-4½"
G	4'-0"	6'-6½"	9'-0½"	11'-7½"	14'-1⅜"	16'-7½"	19'-1⅜"	21'-8½"	24'-2½"	26'-8½"	29'-2½"	31'-9"	34'-3⅜"	36'-9½"	39'-3⅜"
H	12'-0"	12'-0"	12'-0"	12'-0"	14'-0"	12'-0"	12'-0"	12'-0"	12'-0"	14'-0"	14'-0"	12'-0"	12'-0"	12'-0"	14'-0"
I						14'-0"	14'-0"	14'-0"	16'-0"	16'-0"	16'-0"	14'-0"	16'-0"	16'-0"	16'-0"
J												18'-0"	18'-0"	18'-0"	20'-0"
K	14'-0"	14'-0"	14'-0"	14'-0"	14'-0"	16'-0"	16'-0"	16'-0"	18'-0"	18'-0"	18'-0"	18'-0"	18'-0"	20'-0"	20'-0"
L	12'-0"	12'-0"	14'-0"	16'-0"	18'-0"	14'-0"	14'-0"	14'-0"	14'-0"	18'-0"	18'-0"	14'-0"	16'-0"	14'-0"	18'-0"
M						14'-0"	14'-0"	16'-0"	18'-0"	18'-0"	18'-0"	16'-0"	16'-0"	18'-0"	18'-0"
N												18'-0"	18'-0"	20'-0"	20'-0"
O	4'-0"	6'-6"	9'-0"	9'-6"	13'-6"	13'-6"	17'-0"	9'-6"	13'-6"	13'-6"	13'-6"	17'-0"	17'-0"	17'-0"	19'-6"
P								9'-0"	9'-0"	13'-0"	13'-0"	13'-0"	16'-6"	16'-6"	19'-0"
Q	1'-0"	1'-0"	1'-0"	3'-0"	1'-6"	4'-0"	3'-0"	4'-0"	2'-6"	1'-0"	3'-6"	2'-6"	1'-6"	4'-0"	1'-6"
R	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"
S	18'-0"	18'-0"	18'-0"	18'-0"	20'-0"	20'-0"	22'-0"	18'-0"	20'-0"	20'-0"	20'-0"	22'-0"	22'-0"	22'-0"	24'-0"
T								18'-0"	18'-0"	20'-0"	20'-0"	20'-0"	22'-0"	22'-0"	24'-0"

TABLE VI. BILL OF MATERIAL FOR ONE BENT OF STANDARD GAGE TRESTLES

Description	Height	One-Story Bents					Two-Story Bents						Three-Story Bents			
		5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
12"x12"x12'-0" caps		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4"x12"x14'-0" sills		1	1	1	1	1	1									
4"x12"x16'-0" sills								1	1	1	1					
4"x12"x18'-0" sills												1	1			
4"x12"x20'-0" sills														1	1	1
3"x12"x 4'-0" sills		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
3"x 8"x12'-0" brace		4	4	2	2		2	2	2	2			2	2	2	
3"x 8"x14'-0" brace				2		2	6	6	4	2	2	2	4	4	2	2
3"x 8"x16'-0" brace					2				2	2	2	2	2	2	2	2
3"x 8"x 18'-0" brace						2				2	4	4	4	4	4	4
3"x 8' x 20'-0" brace															2	4
5'-0" /9 posts		4														
7'-0" /9 posts			4													
10'-0" /9 posts				4												
12'-0" /9 posts					4											
15'-0" /9 posts						4										
17'-0" /9 posts							4									
20'-0" /9 posts								4								
22'-0" /9 posts									4							
25'-0" /9 posts										4						
27'-0" /9 posts											4					
30'-0" /9 posts												4				
32'-0" /9 posts													4			
35'-0" /9 posts														4		
37'-0" /9 posts															4	
40'-0" /9 posts																4
¾"x18" D bolts		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
¾"x8" B spikes		120	120	120	120	120	200	200	200	200	200	200	250	260	260	260

TABLE VII. BILL OF MATERIALS FOR ONE SPAN OF STANDARD GAGE TRESTLE

Description	Height	One-Story Bents					Two-Story Bents						Three-Story Bents			
		5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
8"x16"x16'-0" stringers		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
6"x 8"x 8'-0" ties		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
4"x 8"x16'-0" brace		4	4	4	4	4	6	6	6	6	6	6	6	6	6	6
¾"x20" D bolts		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
¾"x 8" B spikes		50	50	50	50	50	60	60	60	60	60	60	60	60	60	60
¾"x 9" lin. spike		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

TABLE VIII. BILL OF MATERIAL FOR TOWER DIAGONALS OF STANDARD GAGE TRESTLE

Description	Height	One-Story Bents					Two-Story Bents						Three-Story Bents			
		5'-0"	7'-6"	10'-0"	12'-6"	15'-0"	17'-6"	20'-0"	22'-6"	25'-0"	27'-6"	30'-0"	32'-6"	35'-0"	37'-6"	40'-0"
3"x8"x18'-0" brace		4	4	4	4	..	..	..	8	4	..	..	..	..	..	..
3"x8"x20'-0" brace		..	..	..	..	4	4	4	..	4	8	8	4	..	..	..
3"x8"x22'-0" brace		..	..	..	..	..	..	..	..	..	..	..	4	8	8	..
3"x8"x24'-0" brace		..	..	..	..	..	..	..	..	..	..	..	..	..	..	8
¾"x8" B. spike		50	50	50	50	50	50	50	100	100	100	100	100	100	100	100

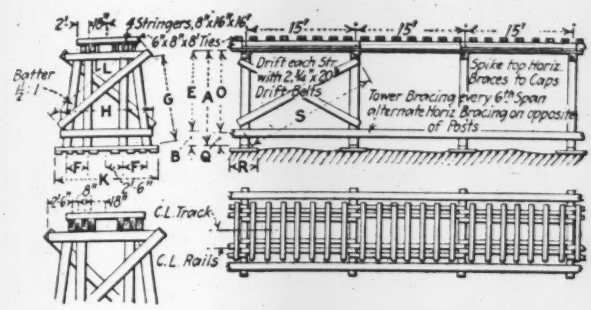

4 Stringers, 8"x16"x16'
6"x8"x8' Ties
15'
Batter 1/2:1
Drift each Str. with 2-3/4"x20" Drift-Bolts
Spike top Horiz. Braces to Caps
Tower Bracing every 6th Span, alternate Horiz. Bracing on opposite of Posts
C.L. Track
C.L. Rails

FIG. 4. STANDARD GAGE TRESTLES FROM 5 TO 15 FT. HIGH

tackle attached to the next previously erected bent. As temporary trestles are built for utility only, and as they will be buried soon after they are built, no expense should be incurred for æsthetic features. The only materials recoverable are the ties and stringers which may be removed on completion of the fill and used again elsewhere. Where longitudinal bracing interferes with the ends of transverse bracing at connections to the posts, the corners of the transverse bracing may be trimmed off with axes, or, where the interference is slight, the longitudinal bracing may be raised or lowered a trifle to clear the transverse bracing.

Economy may be accomplished in the construction of

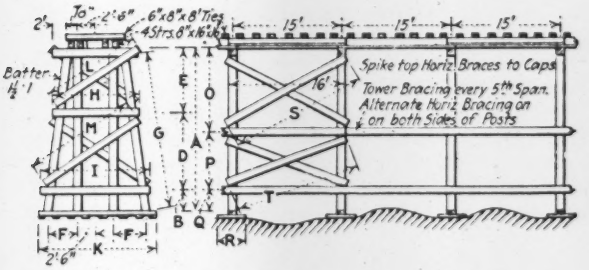

6"x8"x8' Ties
4 Strs. 8"x16"x16'
15'
Batter 1/2:1
Spike top Horiz. Braces to Caps
Tower Bracing every 5th Span. Alternate Horiz. Bracing on both Sides of Posts

FIG. 5. STANDARD GAGE TRESTLES 17½ TO 30 FT. HIGH

TABLE IX. QUANTITIES OF MATERIAL PER LINEAR FOOT OF NARROW AND STANDARD GAGE TRESTLE

Description	Height Trestle	Poles, Lin. Ft.	Caps, M. Ft.	Stringers, M. Ft.	Ties, M. Ft.	Bracing, M. Ft.	Hardware, lb.
		4-Yard Outfit					
1-Story Bent	5'-0"	0.70	0.005	0.023	0.012	0.022	4.50
	7'-6"	0.98	0.005	0.023	0.012	0.022	4.50
	10'-0"	1.40	0.005	0.023	0.012	0.022	4.50
	12'-6"	1.68	0.005	0.023	0.012	0.022	4.50
	15'-0"	2.10	0.005	0.023	0.012	0.023	4.50
	17'-6"	2.38	0.005	0.023	0.012	0.023	4.50
	20'-0"	2.80	0.005	0.023	0.012	0.025	4.50
2-Story Bents	20'-0"	2.80	0.005	0.023	0.012	0.032	5.30
	22'-6"	3.08	0.005	0.023	0.012	0.032	5.30
	25'-0"	3.50	0.005	0.023	0.012	0.034	5.30
	27'-6"	3.78	0.005	0.023	0.012	0.034	5.30
	30'-0"	4.20	0.005	0.023	0.012	0.034	5.30
3-Story Bents	30'-0"	4.20	0.005	0.023	0.012	0.039	6.10
	32'-6"	4.48	0.005	0.023	0.012	0.040	6.10
	35'-0"	4.90	0.005	0.023	0.012	0.042	6.10
	37'-6"	5.18	0.005	0.023	0.012	0.042	6.10
	40'-0"	5.60	0.005	0.023	0.012	0.043	6.10
		Standard Gage Outfit					
1-Story Bent	5'-0"	1.40	0.011	0.046	0.018	0.031	6.55
	7'-6"	1.96	0.011	0.046	0.018	0.031	6.55
	10'-0"	2.80	0.011	0.046	0.018	0.031	6.55
	12'-6"	3.36	0.011	0.046	0.018	0.032	6.55
	15'-0"	4.20	0.011	0.046	0.018	0.033	6.55
2-Story Bents	17'-6"	4.76	0.011	0.046	0.018	0.045	8.50
	20'-0"	5.60	0.011	0.046	0.018	0.046	8.50
	22'-6"	6.16	0.011	0.046	0.018	0.048	8.60
	25'-0"	7.00	0.011	0.046	0.018	0.049	8.60
	27'-6"	7.56	0.011	0.046	0.018	0.051	8.60
	30'-0"	8.40	0.011	0.046	0.018	0.051	8.60
3-Story Bents	32'-6"	8.96	0.011	0.046	0.018	0.060	10.70
	35'-0"	9.80	0.011	0.046	0.018	0.060	10.70
	37'-6"	10.36	0.011	0.046	0.018	0.062	10.70
	40'-0"	11.20	0.011	0.046	0.018	0.065	10.70

trestles for very long fills, in some instances by furnishing only enough stringers to take care of the dumping area of the trains and building the fills up to grade progressively from one end. In this manner the stringers may be removed from the finished fill as it is completed and shifted ahead, thus keeping to a minimum the stock of stringers to be carried. Great care should be taken, however, when fills are constructed in this manner to maintain a very flat slope on the face of the fill or the material will slide forward and force the trestle out of line. Except for very long fills it will generally be found more economical to furnish enough stringers to build the trestle complete, which will enable the building up of the fill in uniform layers

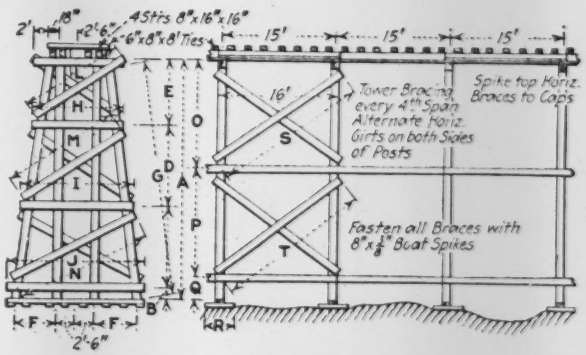

4 Strs. 8"x16"x16"
6"x8"x8' Ties
15'
16'
Tower Bracing every 4th Span Alternate Horiz. Girts on both Sides of Posts
Spike top Horiz. Braces to Caps
Fasten all Braces with 8"x1/8" Boat Spikes

FIG. 6. STANDARD GAGE TRESTLES FROM 32½ TO 40 FT. HIGH

across the entire opening, thus preventing any crowding of the trestle out of line, which is a serious matter. The extra expense of constructing a trestle, strong enough to carry the locomotives, complete at the outset is usually more than compensated for by the elimination of the troubles encountered by dumping from the shoulder from a partially completed structure.

Breaking Ice from Water Tank by Rifle Shots

Ice that had formed on the outside of a new elevated water tank, and on a staging left for use in painting the tank, was shot away in small pieces by firing 600 rounds of soft-nosed bullets from a 44-caliber Winchester rifle, according to a statement by D. C. Winsor in the *Quarterly of the National Fire Protection Association* (Boston, Mass.) for October, 1919. The tank has a capacity of 50,000 gal., and is supported by a 90-ft. steel tower. The tank had been erected to replace an old one during the severe winter weather of 1918. After water had been turned in, a small piece of wood lodged in the check valve on the supply pipe, so the tank overflowed and a large amount of ice attached to the combined structure was formed. As to this ice and its effect on the structure, Mr. Winsor writes: "It is estimated by the tank builders that the extra weight carried by the structure for the time mentioned probably amounted to about 15% or 62,500 lb. extra dead weight. The extra area exposed to wind pressure probably increased the wind load 25%, hence the factor of safety tank trestle was about 3.4 for the posts. Some struts and wind braces had even a smaller factor of safety, owing to the unevenness of the distribution of the extra ice load." Although the ice was in position for about a week, it does not appear, Mr. Winsor states, that it did any damage to the tank or tower.

Complete Vote on Am. Soc. C. E. Questionnaire

IN the accompanying table is given the complete vote, by districts, of the American Society of Civil Engineers upon the Questionnaire based on the report of the Development Committee and sent out to the membership in the form of a letter ballot which was canvassed April 14. The figures are from the canvassing committee's official report to the Board of Direction. Of a total of 4,026 ballots received 3,913 were valid. The 113 ballots excluded from the count consisted of 12 unsigned; 3 letters or telegrams asking the secretary to cast ballot; 50 from members in arrears of dues; 5 from persons not entitled to vote; and 43 with lettered, instead of written signatures. The committee reports that the 43 ballots excluded for lack of written signatures were:

Question	Yes	No
A-1	30	14
A-2	30	13
A-3	18	23
B 1	36	5
2	33	8
3	36	6
4	30	16
5	30	13
6	25	16
7	11	30

For the information of readers in studying the returns the following description of the geographical location of the Society's "districts" and the number of corporate members in each is appended:

District 1—50-mile radius, N. Y. City (1,248), all outside North America (933). Total corporate members, 2,181.

District 2—Maine (36), New Hampshire (25), Vermont (5), Massachusetts (355), Rhode Island (38). Connecticut (110), New Brunswick (6), Nova Scotia (1). Total corporate members, 576.

District 3—N. Y. State (395), Quebec (62). Total, 457.

District 4—Eastern Pennsylvania (441), Maryland (138), New Jersey (76), Delaware (26). Total, 681.

District 5—District of Columbia (310), Virginia (215), North and South Carolina (114), Georgia (84), Florida (60). Total, 783.

District 6—Western Pennsylvania (240), West Virginia (60), Ohio (321). Total, 621.

District 7—Ontario (54), Michigan (147), Wisconsin (60), Minnesota (111), Manitoba (7), Iowa (60). Total, 439.

District 8—Illinois (397), Indiana (57), Kentucky (36), Tennessee (72). Total, 562.

District 9—Alabama (83), Mississippi (30), Louisiana (71), Arkansas (32), Missouri (205). Total, 421.

District 10—Oklahoma (33), Kansas (55), Colorado (86), Utah (39), Nebraska (38), Wyoming (21), North and South Dakota (15), Montana (50), Saskatchewan (2), Alberta (12). Total, 351.

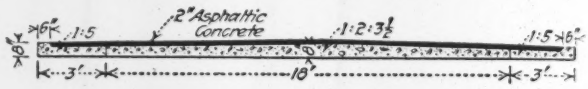
District 11—Texas (182), Mexico (28), New Mexico (12), Arizona (26), Southern California (197). Total, 445.

District 12—British Columbia (15), Idaho (37), Washington (148), Oregon (86), Alaska (12). Total, 298.

District 13—Northern California (398), Nevada (9). Total, 398.

Old Concrete Road Widened at Low Cost

AN old concrete road in Milwaukee County, Wis., constructed of pit-run gravel in 1912, was cheaply widened last year by adding two side strips of concrete and surfacing the whole pavement with 2 in. of asphaltic concrete. It cost about $1.50 a square yard to construct



the side strips, and the surfacing, performed under two contracts at different prices, averaged in cost about $1.17½ a square yard. From the old concrete road 18 ft. wide in bad condition a 24-ft. road of asphaltic concrete on a cement base was secured at an average cost of a little more than $1.50 a square yard.

As originally constructed the concrete slab was 8 in. thick at the center and 6 in. thick at the sides. It was widened 3 ft. on each side with a slab of 1 : 5 pit gravel concrete. A curb 2 in. high and 6 in. wide finished the edge off each slab. With the 2-in. surfacing a practically new pavement, 24 ft. wide, 10 in. thick at the center and 8 in. thick at the edges, was obtained.

The new construction was begun by plowing up the shoulder on one side of the original road to a width required for the 3-ft. slab. The loosened soil was shoveled out and spread to form the new shoulder. Then the bottom of the excavation was hand tamped and concreting begun. For this a one-bag batch paving mixer was employed. When this side slab was completed the operation, working in the reverse direction, was repeated to construct the other side slab. By this procedure the concreting was performed with only half of the road closed to traffic. The asphaltic surfacing was laid to full width in one operation but as this material was in condition in 36 hr. to carry the traffic the surfacing interrupted only slightly the use of the road.

There were 1 1/10 mi. of road widened and the work was completed in six weeks, placing the concrete slab by force account, and the surfacing by contract. The gang placing the slabs averaged about 22 men, five men grading, two setting forms and 15 men placing the concrete.

AM. SOC. C. E. BALLOTS CANVASSED UPON QUESTIONNAIRE

District	A. 1		A. 2		A. 3		B. 1		B. 2		B. 3		B. 4		B. 5		B. 6		B. 7	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1. Resident	472	288	568	192	214	572	484	219	488	236	568	176	411	322	409	331	518	223	460	267
1. Foreign	41	15	46	9	21	35	37	11	39	14	43	9	30	22	29	23	35	17	20	33
2	217	52	241	26	134	135	213	41	198	62	218	37	182	77	179	74	186	76	98	153
3	143	144	160	126	73	215	161	108	156	121	200	82	138	138	138	138	115	174	66	220
4	358	26	356	27	273	108	346	26	334	42	346	35	317	57	312	67	307	73	173	202
5	178	57	194	43	111	126	174	42	171	57	197	33	145	80	164	65	154	82	94	138
6	306	70	324	55	237	134	308	46	302	61	332	39	288	79	300	69	284	87	116	245
7	220	36	222	33	169	84	217	30	222	29	240	16	206	44	211	42	195	58	108	139
8	223	47	238	33	121	150	211	39	216	48	238	31	191	73	196	67	188	73	126	129
9	130	47	143	33	91	94	136	37	133	41	146	32	117	56	126	50	144	60	91	83
10	135	36	139	32	89	82	129	31	139	27	152	15	119	49	126	39	105	60	66	101
11	196	38	204	31	149	85	195	27	191	37	207	24	175	53	177	51	162	65	132	97
12	129	20	130	20	89	58	122	16	126	20	131	18	116	29	116	28	98	50	66	80
13	141	34	150	25	96	76	131	38	139	36	158	20	126	51	130	47	122	51	85	88
Total	2,889	910	3,115	685	1,867	1,954	2,864	711	2,854	831	3,176	567	2,561	1,130	2,613	1,091	2,583	1,149	1,701	1,976
Majority	1,979	....	2,430	....	....	87	2,153	....	2,023	....	2,609	....	1,431	....	1,522	....	1,434	....	....	275

House Committee Condemns Army Camp Construction

Majority Report Alleges Loss of Millions Due to Waste, Inefficiency and Cost-Plus Form of Contract

SELECT Committee on Expenditures in the War Department has submitted to the House of Representatives a report of Subcommittee No. 2, on camps, as its own report on the investigation which has been held for some months into the construction of the draft army cantonments which were built in the summer of 1917. The report, which is not signed, is accompanied by a minority report signed by Representatives Flood, Doremus, Donevan and Lea, all Democrats. The majority report is a scathing criticism of the whole method and practice of building the camps, including an indictment of the cost-plus contract as the cause of waste and profiteering, together with recommendations for a method of conducting similar work in future emergencies. The minority defend the methods and men criticized and disagree generally with the report.

The object of the investigation was "to inquire not only into the legality or illegality, but also to the propriety or impropriety and recklessness of the expenditures and to determine whether the contracts and system under which such expenditures have been made were made necessary by reason of the emergency existing, or whether they should be condemned and expressly prohibited in any future emergency which should arise." To this end the committee had many hearings and listened to testimony from many men, from workmen on the camps up to the responsible heads of the bureaus and committees concerned, all of which it is stated, is contained in supplementary documents. Such quotations or abstracts as are quoted are mainly from those whose testimony backs up the findings of the majority. The printed document contains 174 of the regular Congressional document octavo pages.

The first concern of the committee was as to the authority of the Council of National Defense to constitute the Emergency Construction Committee, of which Col. W. A. Starrett, the New York architect, soon became head, and which, in effect, formulated the policy of camp construction and contracts. It finds that the intention of Congress was "perverted from its clear intention and transcended, particularly in matters relating to construction work." It finds, further, that the Emergency Construction Committee usurped the functions of the Cantonment Division, then a part of the Quartermaster Corps of the Army, and that this usurpation consisted mainly in establishing a cost-plus form of contract and in selecting the contractors without the usual governmental form of calling for competitive bids. Specific charges are made that the committee, itself made up of architects, engineers and contractors (with one Army engineer who, in the language of the report, "was too busy to attend" the meetings of the committee), called into its deliberations hundreds of other contractors and that "many of the contractors who received the most lucrative fees did take part in the discussions and help formulate the contract, so far as the fee and what was to be done for it were concerned." More than mere insinuations are made that some of the committee, through relatives or firm affiliations, benefited by contracts.

The cost-plus form of contract as used in the cantonment construction is criticized in detail in that it did not provide adequate supervision over audits, permitted undue extension of overhead charges, and gave exorbitant fees for what was practically personal service inasmuch as the Government paid separately for plant and organization. Its method of award, it is claimed, permitted favoritism.

The committee cites the various arguments made in favor of the cost-plus contract, but denies their validity. It denies that the method led to increased speed in construction, but caused delay in the initiation of the work, its progress and its completion. This delay was due to the time consumed in formulating the contract, in surveying the contractor field "instead of calling contractors in promptly to bid competitively," neglecting any bonus for speed, loss of time due to decreased morale of the workmen and the indifference of the contractor in getting a fair day's work and recklessness with men and material, for the cost of which the contractor was not responsible.

Claims that lump-sum bids could not be taken because of the inadequacy of the early designs of the camps are not accepted by the report. It states that most of the work was the repetitive building of a simple frame barracks and that a design for an adequate building of this sort had long been prepared by the Army. Bids could have been taken for these as units, and the sewer, water and other public services let on a unit price basis. There is an alternative suggestion in an isolated part of the report that the Corps of Engineers could have gone in on every site and started work on a day-labor basis until such time as the plans could be sufficiently developed to permit lump-sum bidding when the work could have been turned over to the successful contractor.

The committee takes no stock in the claim that "the fluctuations of the material market and of the wage scale were such that no responsible concern would have bid, or even if they had bid that their bids would have been unreasonable." It had testimony from some contractors that they were ready and willing to bid for the construction of the cantonments according to the lump sum or unit price method. One such contractor testified that he would have built Camp Grant (one of the two camps examined in detail by the committee) for $9,000,000 as against the $13,000,000 it actually cost.

The major part of the report is given over to proofs of the waste and inefficiency of the camp construction, taken mostly from testimony of workmen on the two camps investigated These charges consist mostly in specific descriptions of loafing, double-pay taking, material wasting, misdirected effort, etc., which came under the observation of the witness Mainly as a result of this testimony, the committee finds "that one of the most far-reaching and serious results of the cost-plus system was the utter demoralization of labor, both skilled and unskilled," a condition which "still continues, and no end thereof nor relief is in sight." The report hastens to add, however, that "generally, organized labor took a reasonable view of the situation, and at times tendered its services to better conditions, which apparently were refused, when tendered."

As a result of the waste and inefficiency revealed it is the conclusion of the committee that the cantonments cost from 40 to 60 per cent more than they should, or that about $80,000,000 could have been saved.

It specifically finds Secretary of War Newton D. Baker responsible for the "entire situation resulting, including violations of law, defrauding, waste, losses and delay," and Col. W. A. Starrett, with his associates on the Emergency Construction Committee, responsible for introducing the criticized policies and for the methods of their administration. The committee recommends that the legal departments of the Government should forthwith proceed to recover from those who received undue amounts of money for the cantonment work, but specifies only a few minor instances of dereliction.

The committee recommends that legislation be enacted prohibiting any Government construction being done on a cost-plus basis, either in emergency or normal times, and that Congress make provision to place all engineering and construction work for the Army under the Corps of Engineers. It states that in its opinion the Construction Division, as now constituted, appears to be in sympathy with the contractors in theory and fact. Finally it recommends an amendment to the Constitution of the United States "to make profiteering in war times treason."

THE MINORITY REPORT

The minority report defends the adoption of the cost-plus contract in the emergency. It states that "the clear weight of the testimony is that the usual method of advertising for bids and awarding contracts to the lowest responsible bidder on a lump-sum or fixed-cost basis was not only impossible but would, if adopted, have resulted in disaster to this vital construction program. It must be remembered that the plan which is so severely condemned by the majority was successful in accomplishing the object in view. If a different plan had been adopted, and had failed, our troops would have reached the camps without shelter, heat, water or sanitation. Such a hazard was unthinkable. The only way in such an emergency was the sure way." It further contends that statements of what bids would have been, made two years after construction started, are worthless.

The minority defends the form of contract and the method of its formulation. It believes that a great number of responsible Government officials were concerned in deciding upon the contract and that under the conditions existing their collective judgment was unanimous and justified. It further thinks that the Government was amply safeguarded against loss, insofar as could be foreseen. Bonuses, it contends, were impossible in a contract the time or quantity of which could not be predicted.

A large part of the minority report is given over to the professional records of the men criticized by the majority and a defense of their actions. Particularly does the minority defend the calling in of construction experts to advise on the provisions of a construction contract and on the methods of carrying it out. It claims that the camps were finished in a marvelously short time and without undue cost, considering the times. The wastes cited by the witnesses were specific and minor in the particular, and bore only a small proportion to the enormous cost of the projects. Testimony was heard to the effect that up to 50 per cent of the lumber had been wasted at Camp Sherman. Actual figures show that all but 10 per cent of the lumber delivered is accounted for in the structures.

The final opinion of the minority is that "the Secretary of War was amply justified in abandoning the usual peace-time method of awarding contracts upon competitive bidding and in substituting for it the so-called cost-plus system for cantonment construction" and that "if the views of the majority had been adopted at the beginning of the war, the whole building program would have been in a state of chaos, many of our troops would have perished with cold or died of disease in the winter of 1917, and the German Army would have been in Paris before our soldiers could have entered the battle lines."

Alaska Railway Work for Season of 1920

CONSTRUCTION and preparatory work for the season of 1920 on the southern and northern sections of the Alaska Government Ry., as outlined by Col. Frederic Mears, chairman and chief engineer, Alaskan Engineering Commission, includes heavy bridges and rock-cut work, as well as new grading and repair of old grades. A map of the Alaska Ry., extending northward from Seward 470 miles to Fairbanks and from that point 39 miles to Phalaluka was shown in *Engineering News-Record* Jan. 2, 1919, p. 46, indicating progress to that time.

The contract has been let for the 504-ft. truss span over the Susitna River, 265 miles north of Seward. Examinations are being made for the foundations of the Hurricane Gulch steel arch bridge 284 miles north of Seward, which will be the northern limit of operation for the southern division this year. It was necessary to start excavation at this point early in the season owing to the heavy yardage in the approach cut. Several miles of sidehill grading work will be carried out by steam shovel along the Susitna River. North of this work, in the same locality, about 24 miles of regrading are required to repair the old grade which has deteriorated badly at several points owing to its abandonment in 1917-18. Distribution of supplies and materials from the present end of track, 237 miles north of Seward, for a distance of 38 miles northward was carried out during the winter months by sledding over frozen roads.

On the northern division construction will be confined to Nenana Canyon, over a distance of about 10 miles, 120 miles south of Fairbanks, from the present end of track. Here engineers have been assigned to construction sections and six station gangs have made contracts for heavy rock-cut work.

Aërial Tramways for India

Projects for the construction of aërial tramways of ropeways for public traffic in India are under consideration by the Government Railways Board. In the Board's report for 1919 it is stated that this system of transportation is well established in India for mining and other private industrial enterprises, but has not been used for public service. It is considered that experience in other countries has proved this system suitable for the opening up of mountainous districts where the cost of railways or roads would be prohibitive, and there is a wide field for its employment for this purpose in India. As there is difficulty in securing engineers with experience in this line of work, the Board is arranging to have an officer trained specially in aerial tramway construction.

Truss Centering Used for 113-Ft. Concrete Arch

Timber Howe Truss Adopted Instead of Falsework Because of Depth of Water in Channel of Rogue River Bridge

By C. B. McCullough

Bridge Engineer, Oregon State Highway Commission, Salem, Ore.

Owing to the depth of water in the channel of the Rogue River at Rocky Point, Ore., where a 113-ft. concrete arch bridge was to be built, it was decided that a trestle type of falsework was impracticable and instead a timber Howe truss, centering support was used. The view and details herewith show the construction. The arch centering was carried on two 96-ft. trusses, one to each arch rib, each truss being swung from a bank. Stresses and deflections were computed as shown in Fig. 1, and the falsework camber adjusted accordingly. Concreting on the right arch rib was commenced at 10:50 a.m., Nov. 6, 1919, and was finished the same day at 5 p.m. The left arch rib was begun at 8:30 a.m., Nov. 8, and finished at 4:15 p.m. the same day. A comparison between the computed deflection and the actual measured deflection immediately after concreting, and also after the concrete had been in place 15½ hr. is shown above. No further settlement was observed.

The trussed centering was very carefully braced and gone over immediately before concrete was poured; the end posts and end panels of the lower chord were braced at their mid points transversly and the entire framework strutted in such a manner as to eliminate to the maximum possible extent cross bending due to column action. Concreting operations were very carefully watched and the agreement between theoretical and calculated deflection was as close as could possibly be desired.

The general features of the design for this structure and description of the keyways which were contemplated for anchorage of the rib bars against negative bending stresses at the skewback, appeared in *Engineering News-Record* Nov. 27-Dec. 4, 1919, p. 924.

The method for anchorage therein described was modified somewhat during construction, owing to the disclosure, after excavation had developed, of several fissures in the rock which appeared to render any anchorage by the method contemplated more or less uncertain. It was therefore decided to excavate beyond the original keys into the solid rock and to grout in place at each skewback four 2½-in. swedge bolts. These bolts were given a length sufficient to insure a penetration into the solid rock of 5 ft. and were hooked around 2½-in. round transverse bars, computed to carry the

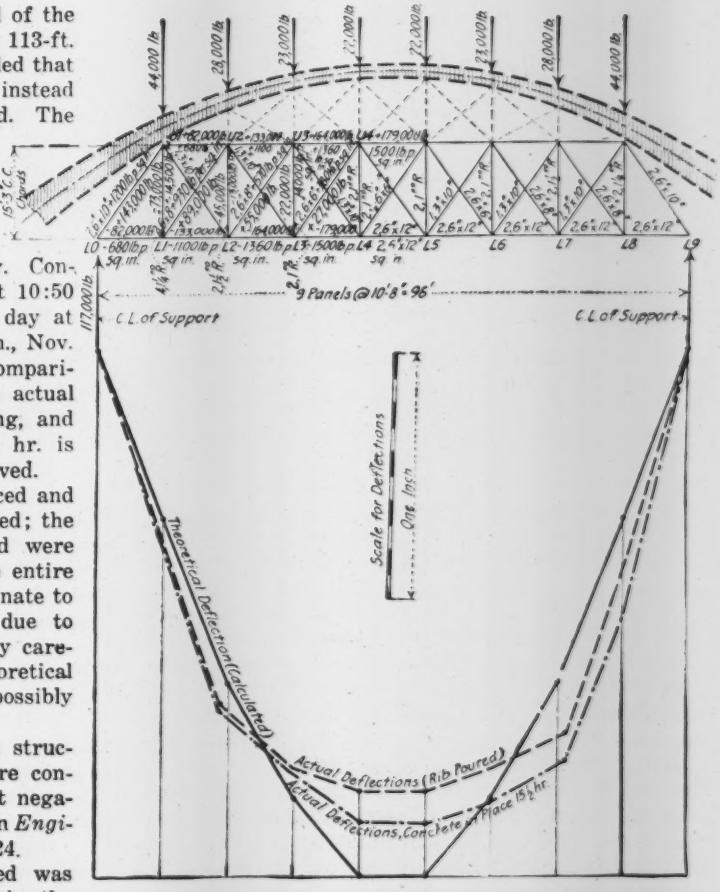


FIG. 1. STRESSES AND DEFLECTIONS IN HOWE TRUSS CENTERING FOR ROGUE RIVER ARCH

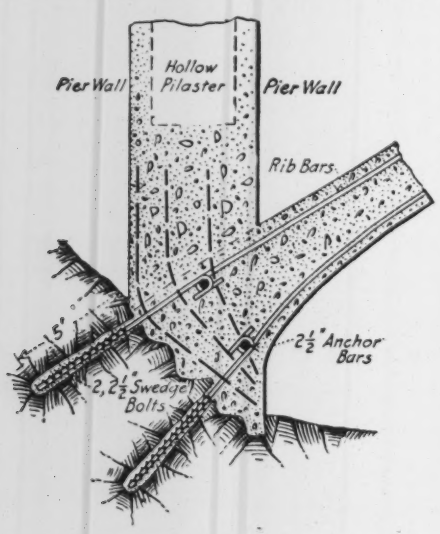


FIG. 2. TYPICAL ABUTMENT DETAIL AS BUILT IN ROGUE RIVER ARCH

bending strain due to the tension on the rib bars. The rib bars in turn were hooked around these anchor bars and a slight tension taken on the same as pouring commenced. The method of anchorage finally adopted is given in Fig. 2.

Metering Federal Government Buildings

Progress in metering Government water service in the District of Columbia is being made, according to the 1918-19 annual report of M. C. Tyler, Colonel of Engineers, U. S. A., in charge of the Washington Aqueduct and District of Columbia filtration plant. During the year meters were installed on a number of Government buildings, including the Patent Office and White House, and on 92 parks and reservations. Colonel Tyler says: "The District engineer points out the impossibility of determining in advance the needs of the District without records as to the consumption of Federal buildings, and also the difficulty of fixing the responsibility for the waste of water where large consumers have a wholly unmeasured supply." As indicating the huge consumption and the possible economies that might be brought about in Government buildings, even when metered, the report states that for the last fiscal year the average daily consumption at the Government Printing Office was 2,527,300 gal. This large use is due to the use of filtered water for condensing purposes, which might be reduced by supplying the printing office with power either from the new central power plant or from the capitol power plant, both of which use untreated river water for condensing, or a reduction in consumption might be brought about by installing cooling towers in the building. The report adds that "this method is not always entirely satisfactory in operation." Any one of the methods suggested, the report states, would reduce the water consumption at the Government Printing Office from 2,527,300 gal. to an estimated 550,000 gal. a day. At 5½c. per 1,000 gal. this would amount to $39,694 a year, besides which the District would be saved "its present heavy expense for pumping condensing water through the sewers."

Progress and Costs on Erie, Pa. Flood Control Project

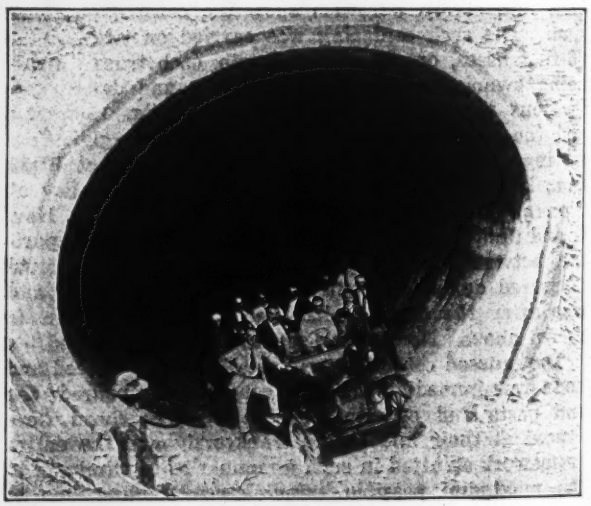
Mill Creek Which Flooded City in 1915 Enclosed in Concrete Tube—Bids Varied Due to War Conditions

BY FARLEY GANNETT
Gannett, Seelye & Fleming, Engineers, Harrisburg, Pa.

CONSTRUCTION of the flood protection works at Erie, Pa., involving the covering of Mill Creek flowing through the city, is progressing favorably. Work has been carried on continuously since the initiation of the project, although the rising costs, due to war-time conditions, have materially changed the original estimates. An analysis of these changing costs gives an interesting commentary on the difficulties of carrying out public work today. A description of the engineering features of the project appeared in *Engineering Record*, Oct. 9, 1915, p. 440 and *Engineering News*, Nov. 11, 1915, p. 937.

Mill Creek enters Erie at its southern limits and flows north through the city, discharging into Lake Erie by way of Presque Isle Bay. On August 4, 1915, this ordinarily mild little creek of twelve square miles of drainage area, overflowed its banks and caused a loss of thirty-four lives and several million dollars of property, repeating an offense which has recurred at about twenty-year intervals for many years of the city's life.

Following a thorough study of the situation an engineering report was submitted to the city recommending the construction of detaining dams south of the city and a concrete tube to carry the resultant regulated flow. An alternative plan in the same report was to construct



COMPLETED 22 x 18-FT. TUBE CARRYING MILL CREEK THROUGH CITY OF ERIE, PA.

a concrete tube to carry the entire flow of the creek. Although the recommended plan was cheaper, the unfortunate fear which exists in many communities regarding dams brought about the adoption of the alternative plan.

The adopted plan called for the construction of a concrete tube of uniform dimensions throughout except for short transition sections at the ends, extending from the southern limits of the city to the north of the creek, a

distance of approximately two miles. For the greater portion of its length it lies in the old creek channel except for occasional departures to secure better alignment. The tube is "tomato" shaped, and measures internally 22 ft. horizontal, and 18 ft. vertical diameter. At the intake end converging concrete walls about 1,000 ft. long conduct the water into the tube and accelerate it to the proper velocity. At the outlet end are diverging walls about 400 ft. long to bring the velocity by expanding section back to normal.

A contract for the entire project was let in December, 1916, and construction started in May, 1917, but difficulties due to the war forced the contractor to discontinue work after several hundred feet of tube had been completed and the major portion of the outlet.

In July, 1918, a second contract was let covering about 4,000 ft. of tube at the upper end and the completion of the outlet. This contract was successfully completed in August, 1919, and the creek is now flowing through this part of the tube.

A separate contract was let for the intake in July, 1919, and this part of the work is now about 90 per cent completed.

On August 1, 1919, a contract covering the balance of the work, about 8,000 lineal feet of tube was let to the Folwell-Ahlskeg Co., which firm had previously completed the upper third of the work.

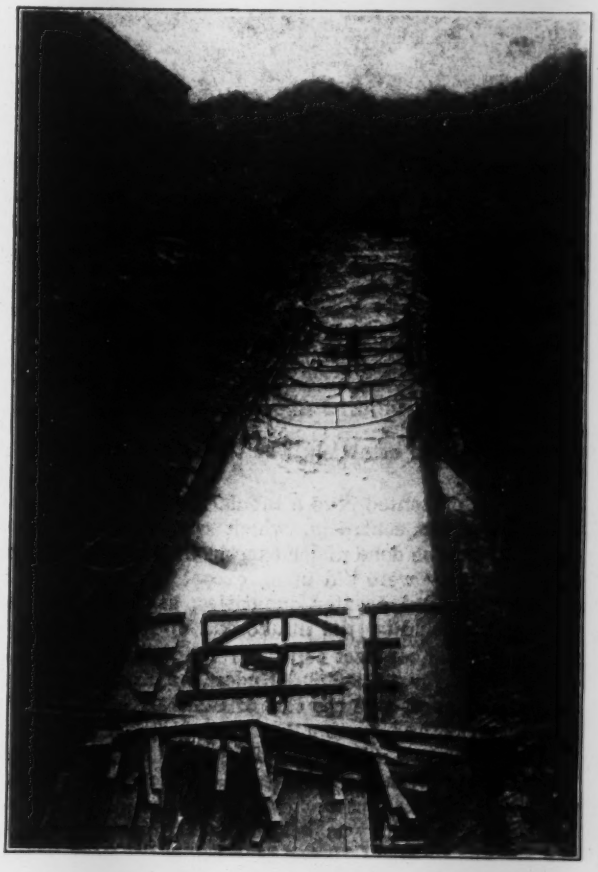
The tube is being constructed by the cut and fill method. Excavation for the first 4,000 ft. of the tube was made by drag line, the spoil being hauled away by dump cars drawn by dinkey engines. On the present contract, however, the excavation is being made entirely by steam shovels and the spoil is being moved by wagon trains drawn by caterpillar tractors.

Near the south end of the work a central concrete plant has been erected where all the concrete ingredients are hauled by belt conveyors and arranged so as to require a minimum of labor. Concrete is hauled from the plant by an industrial railway, the tracks of which are laid along the top of the tube. Tube concrete is placed in 60 ft. sections, and about six hours are required to pour a section. The most careful preparations have been made for heating materials and keeping the concrete at the proper temperature until setting takes place so that the work can be carried on during the winter.

The Erie Concrete & Steel Co. are contractors for the intake work and the Folwell-Ahlskeg Co. for the tube. Gannett, Seelye & Fleming, Inc., were retained by the city to make the original reports and have been in charge since that time.

This work has been let to contractors in whole or in part at three different times. The first was in 1916 when war prices had hardly begun to affect costs or bid prices, as at that time there was little anticipation that this country would become involved. The second time was in May, 1918, in the utmost activity during the war, and the work was undertaken with the approval of the Government to assist transportation and housing conditions in the city of Erie. The third time was in July, 1919, nearly a year after the armistice, just as the resumption of work was showing its effect in rising wages and material costs. Particularly did the great amount of highway work being started, bring about a labor shortage and consequent increase in wages.

In 1916 wages were about 25c. an hour and labor was relatively efficient. This was the prevailing wage on the



PLACING THE INVERT OF MILL CREEK TUBE
In background metal screeds hung from timber frames to form invert.

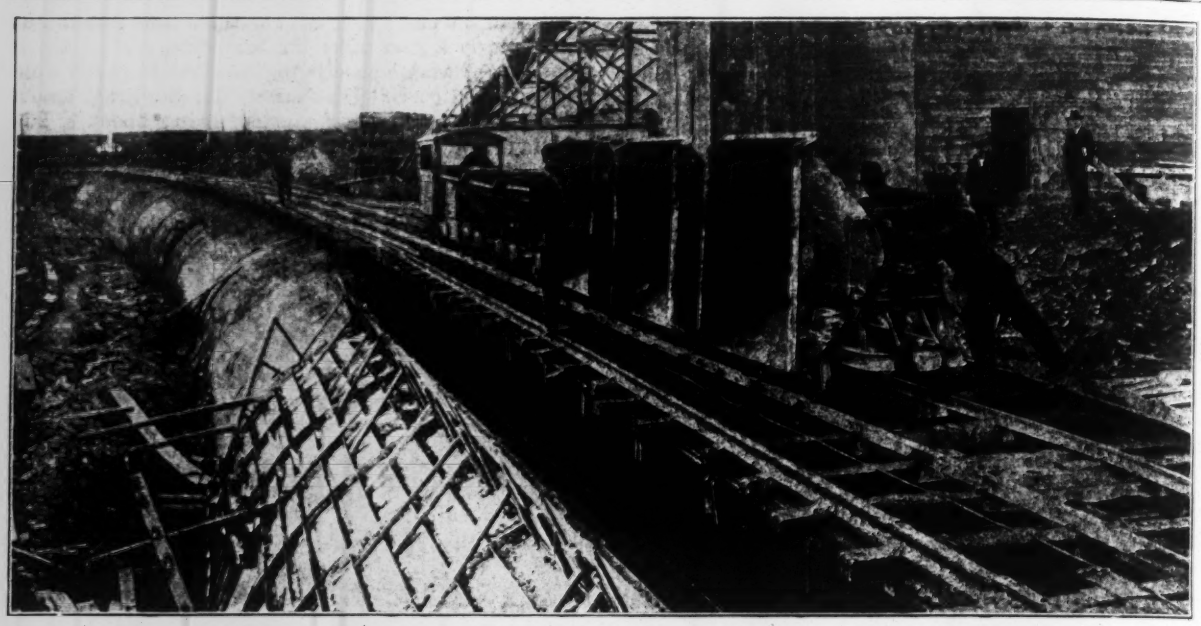
work through the first part of the original contractor's execution of the work he accomplished. Rising prices brought about his failure and bankruptcy, and the work shut down.

When in July and August, 1918, the second contractor started work, he paid first 40c., then 45c. and finally 50c., and 55c. an hour until the armistice, when wages dropped to 50c., 45c. and 40c. in the winter of 1919. When he completed Section 2 in June and July 1919, wages were working up again to 45c. and 50c.

When the third contract was let in August, 1919,

TABULATION OF QUANTITIES AND PRICES ON ERIE FLOOD PROTECTION WORK, 1916-1919

Item	Description	A — Dec., 1916 Entire Job		B — May, 1918 Sections 1 and 2		C — July, 1919 Section 3		C — July, 1919 Section 4	
		Quantity	Unit Pc.	Quantity	Unit Pc.	Quantity	Unit Pc.	Quantity	Unit Pc.
1	Excavation: Class A—Earth	81,000 cu.yd.	0.45	4,350	1.40	29,000	1.90	30,000	1.14
2	Excavation: Class D—Rock	110,000 cu.yd.	0.80	30,000	3.00	39,000	3.33	33,000	2.38
3	Concrete—Class A	49,000 cu.yd.	4.65	14,190	9.80	17,600	9.98	17,200	11.40
4	Reinf. Steel: Furnished and placed	600 tons	100.00	.....	.....	105	95.00	306	95.00
5	Portland Cement: Placed in work	85,000 bbl.	1.50	20,000	2.66	28,500	2.85	26,500	2.85



CONCRETE DEPOSITED IN ARCH FROM TRACKS MOUNTED ON INTERIOR METAL FORMS

wages were well established at that level, and have remained so.

There is presented here a tabulation of the important items in these contracts, which covered exactly the same work to be done under exactly the same conditions each time they were bid upon, except that the original contract involved greater quantities, as it covered the whole job, including the intake and outlet.

The original contract called for the completion of the entire work for $812,000. Under the three contracts above mentioned, plus the cost of Contract No. 5 for the intake works, and Section 1, the outfall, the entire job will cost about $1,800,000. The 1916 contract prices were too low even for 1916, and the contractor would undoubtedly have lost money had war prices not been involved. The bid was below the engineer's estimate and $80,000 or about 10 per cent below the next lowest.

The table brings out some very interesting things. Noticeable among these is the lower cost of reinforcing steel, which was $100 per ton in 1916 and $95 in 1919. One explanation is, that the contractors who bid $95 had learned to place it very cheaply in Section 2, also steel prices were high in 1916 due to foreign demand for munitions. Next to steel, the item for portland cement furnished and in place was the most stable, increasing from $1.90 to $2.85 per bbl.

Earth excavation increased from 45c. per cu.yd. in 1916 to $1.40 in 1918, and to $1.52 in 1919, the latter being the mean price on Sections 3 and 4. In Section 3 the work passes through a thickly built up section under numerous streets, car tracks, factories, apartment houses and residences. Thus the bid for excavating earth in Section 3 is $1.90 and in Section 4, $1.14, while rock costs $3.33 in Section 3, and $2.38 in Section 4. The fact that there is little local spoil area in Section 3 adds to the lenth of haul and to the cost. Undoubtedly the original price of 45c. was too low, even for 1916. The rock excavation price of 1919 is four times that of 1916, which was also far too low for that period.

Concrete materials and placing, excluding cement, more than doubled in price between December, 1916, and May, 1918, and increased another 10 per cent for the average of Sections 3 and 4 by July, 1919.

It should be remembered in comparing the costs in 1916 with 1918 that the quantities are very different, the former being for the whole job, and the latter for about one-quarter of the whole work. An idea of this difference in cost resulting from the extent of the work may be gained from the fact that the successful contractors in Sections 3 and 4 reduced their prices on both sections 5 per cent when awarded the two sections as against their bids on either section singly.

Careful study of the May, 1918, prices on Section 2 and July, 1919, prices on Section 4, which are more nearly comparable than Sections 2 and 3, shows reductions on most items but concrete. The reduction in earth excavation price from $1.40 to $1.14 is due chiefly to the larger amount of it to be handled, 30,000 cu.yd. as against 4,350 cu.yd. The rock excavation is about the same in the two contracts, and shows a reduction from 1918 to 1919 of $0.62 per cu.yd., or nearly 20 per cent.

When the bids of May, 1918, were received there was every prospect of the continuance of the war for a considerable period, and the element of risk of rising prices, freight and material delivery delays, labor shortage, etc., was great, so that these bids probably had a large leeway for covering such risk. This danger was eliminated with the armistice when wages were suddenly but temporarily lowered, and labor became more abundant. This period of lessened costs added to the very mild winter, enabled the cutting of costs considerably and let the contractor out with a fair profit.

Design of Trestle Girders for Coal Pier

Through an error in make-up and transcribing from blueprints a drawing indicating plate-girder construction was used at the bottom of page 761, *Engineering News-Record*, April 15, 1920, in connection with the article on the new coal pier of the Central Railroad of New Jersey. The drawing should have shown 15 ft. spans consisting of two 24-in., 80-lb. I-beams with 15-in., 33-lb. channel stiffeners, placed 5 ft. apart.

Additional Water Supply for the City of Chicago, 1920-55

Plans Involve Doubling Capacity in 35 Years at Cost of Sixty Million Dollars—Selective Metering Only Proposed

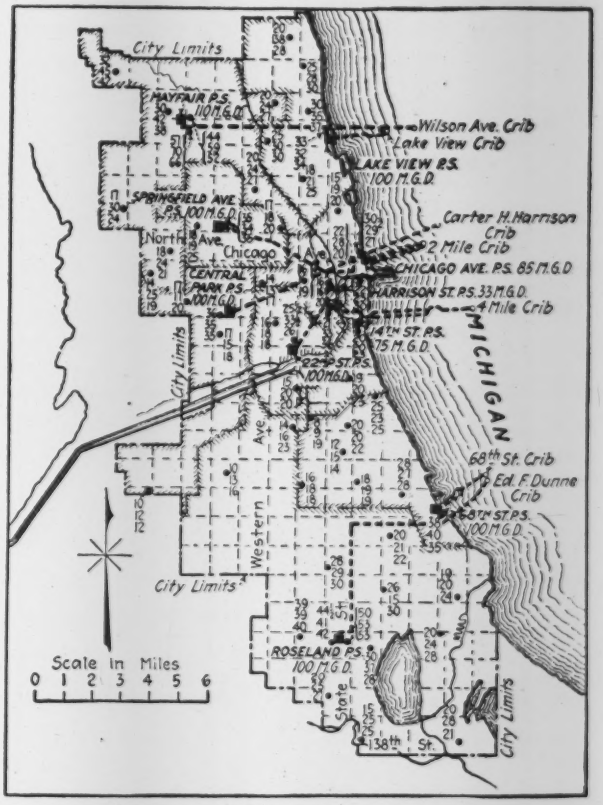
PRACTICALLY a complete reconstruction or revision of the water-works system of Chicago will be undertaken within the next 35 years if the comprehensive plans of P. S. Combs, city engineer, are carried out. The capacity would be doubled, new intake cribs built, pumps added to nearly every pumping station, three new stations built, two stations completely electrified and the distribution system from the pumps and the inland tunnels to the wet wells would be unified and interconnected, all at a cost of more than $60,000,000, of which $4,419,100 would be spent in 1920. The plan does not embrace universal metering but a continuance of the past practice of metering only the taps of those who waste wilfully. By 1940 60 per cent only of the services would be metered. Former plans have been based on much more rapid installation of meters.

The direct pumping system of Chicago consists of a series of intake cribs in Lake Michigan connected by tunnels to the suction wells of pumping stations, most of which were located originally near the shore line. In general, the plan aims to extend the tunnel system so that the stations will be near the centers of their respective distribution systems and also alongside railroad switch tracks. Full electrification of pumping plants, so as to eliminate coal and ash haul, is proposed for the Chicago Ave. and Hyde Park stations. Eventually a north and south land tunnel in Western Ave. interconnecting the three intake systems would be built. The controlling idea has been to interconnect the whole system so that in case of accident to any one pumping station, crib or tunnel, service could still be obtained from the unit adjoining.

Preliminary study of the problem consisted of a comprehensive survey of the whole area of the city, taking each square mile as a unit. Data were gathered as to the population and water consumption from 1890 to date. The curves were extended to 1940. Personal surveys were made of each of the 200 sq.mi. to record areas devoted to domestic and industrial uses, parks and railroads and areas unimproved. The general trend of improvements to and from districts was taken into consideration.

Throughout the preliminary work the unit of 300 gal. per capita daily of maximum consumption was used, this being slightly less than the present maximum requirements. The average was taken at 240 gal. at the present, this amount gradually decreasing to 160 gal. per capita in 1940, at which figure the consumption was assumed to remain constant. Discussing per capita consumption, the report warns the reader not to confuse maximum and average per capita figures. On maximum consumption the system must be built, whereas the average has nothing to do with the capacity of the system although it is the governing factor in the cost of operation. The maximum load is controlled by the use and leakage of water, and can be lowered by stopping leaks both above and below ground and by educating the consumer to use but not abuse the water system.

From the data secured a district was laid out for each pumping station to serve, due consideration being given to the present location of stations, equipment, possibilities of enlargement without undue cost, present mains supplied, additional expenditures necessary, economy of operation and upkeep and service to the consumer. After these districts were laid out it was found that a large section in the southwest part of the city could not now or in the future be supplied from existing stations in an economical manner; nor even by sacrificing economy of operation could adequate service be rendered. The William Hale Thompson station at Forty-seventh St. and Western Ave. was



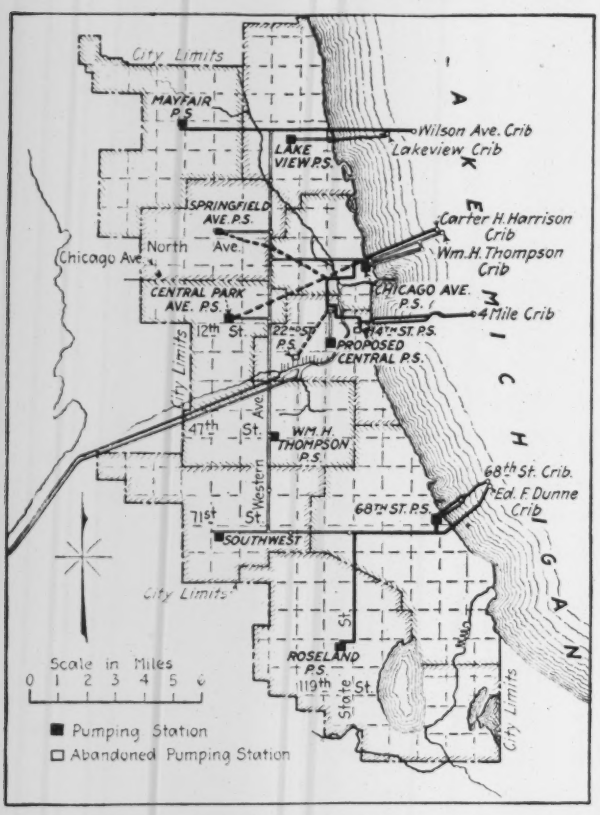
PRESENT PUMPING STATION DISTRICTS WITH RESULTING PRESSURES

Capacities of the stations ("P. S.") in millions of gallons per day ("M. G. D.") are maximum daily performances. The round black dots represent gage stations and the upper, middle and lower figures are gage readings on July 26, Sept. 4 and Dec. 10, 1919, respectively.

decided upon for immediate construction and also the Southwest station at Seventy-third St. and Central Park Ave.

At present many districts are without service at the peak load. Had adequate service been given in 1919 it is estimated an additional 200,000,000 gal. daily capacity would have been required. This amount is in excess of all existing reserves. Results of a detailed survey of water pressures indicate that under average conditions quite a number of sections have the required 25 lb. pressure necessary to give service on the third floor of buildings, but there are many districts below 20 lb. Some sections are always below 15 lb. and still others below 10 lb. When the maximum load occurs all of these pressures drop anywhere from 3 to 8 lb. Pressure gage readings on three dates are indicated on the drawing that shows the present pump-

ing station districts. The plan outlined to eliminate this low pressure condition involves numerous additions to the four existing pumping stations which now have a capacity of 928,000,000 gal. daily and a reserve of 193,000,000, although all of the reserves were not available in 1919 when the highest recorded daily consumption was 948,000,000 gal. The estimated total



ULTIMATE PUMPING STATION DISTRICTS, NEW TUNNELS AND CRIBS

requirements, working capacities and reserve capacities in million gallons daily will be as follows if the program proposed is carried out:

	Required	Working Capacity	Reserve Capacity
1919–1920	1,072	928	193
1920–1925	1,109	1,127	284
1925–1930	1,354	1,343	392
1930–1935	1,576	1,713	642
1935–1940	1,799	1,863	485
1940–1955	2,031	2,060	545

Some of the more important proposed changes and installations at the pumping stations are as follows:

Lake View Station: The five original boilers have never been given a certificate to operate by the city boiler inspector. Three have been condemned and sealed by the inspector. A boiler consigned to the Springfield Ave. station was diverted last year to Lake View and is carrying the full load. In consequence, new boilers are needed at once. As the station is not on a railroad it is planned to replace it in 1934 at a cost of $2,200,000 by a new station located near the center of the district.

Springfield Ave. Station: This 20-year old station has obsolete, worn-out, cracked cylinders. Complete rehabilitation is essential, during which the new Mayfair station would carry the load. Three triple-expansion pumps from Chicago Ave. are to be moved to this station.

Central Park Ave. Station: Conditions similar to those exist at Springfield Ave., but new units must be purchased.

Chicago Ave. Station: On account of its architectural and sentimental value, this station, although located at the extreme east side of the district and away from the railroads, will be maintained but completely electrified and its present steam units transferred to the Springfield Ave. station.

Fourteenth St. Station: This is a coal-haul station but to maintain service to its districts it needs much additional capacity. It, together with the Twenty-Second St. and Harrison St. stations are eventually to be replaced by a single new station on which it is planned to start work in 1921. On completion of the new station in 1924 the three old stations would be abandoned. The new station is planned as a standby service for the Loop district in case of any accident to the Chicago Ave. station.

Sixty-Eighth St. Station: Complete electrification is planned for this station, which was acquired through the annexation of Hyde Park and has given much trouble from unsatisfactory and worn-out units. The station will not be moved to the center of its district because to do so would mean the scrapping of its distribution system.

Roseland Station: This new station is unable to give good service over the 85 sq.mi. of area in its district since the "haul" is too long and friction head too great. The revamped Sixty-eighth St. station will supply a large portion of the eastern side of the Roseland's district and eventually the proposed 300,000,000-gal. William Hale Thompson station will care for all of that portion north of Seventy-ninth St. The proposed 160,000,000-gal. Southwest station would care for a part of the district now supplied by Roseland, which will later be taken over in part temporarily by the William Hale Thompson station.

Chicago has seven cribs and it is proposed to add one more. Four are in good condition but three need repairs. It is planned to start construction on the new William Hale Thompson crib alongside the Carter H. Harrison crib in 1920 and complete it in 1923. A 20-ft. tunnel will connect it with the shore near Chicago ave., also connecting it there with the four existing tunnels, and then extending it west to Western Ave., eventually connecting north and south with the Springfield and Central Park stations. The William Hale Thompson station will be served at first from the southern crib system but eventually tunnel connections in Western Ave. north from this station and south from the Wilson Ave. tunnel would be completed, thus interconnecting the whole tunnel and crib system and giving four points at which the north and south tunnel could be tapped.

Financially, the plan calls for a total expenditure of $61,439,000 by 1950. In 1920 there would be spent $2,200,000 on pumping stations. $780,000 on tunnels, $439,000 on cribs and $1,000,000 on water pipe extensions. Similar heavy expenditures are proposed for the succeeding five years. It will be necessary to float a loan in 1921 to meet the costs in excess of the revenue and to continue to make loans until 1928 when $15,000,000 would have been borrowed. A retirement fund would be started in 1929 and wipe out the loans by 1935.

St. Louis Tunnels Unwatered by Air Lift

Difficulties With Other Types of Pump—Two-Stage Air Lift Has Capacity of 3000-4000 Gallons per Minute—Maximum Head 76 Feet

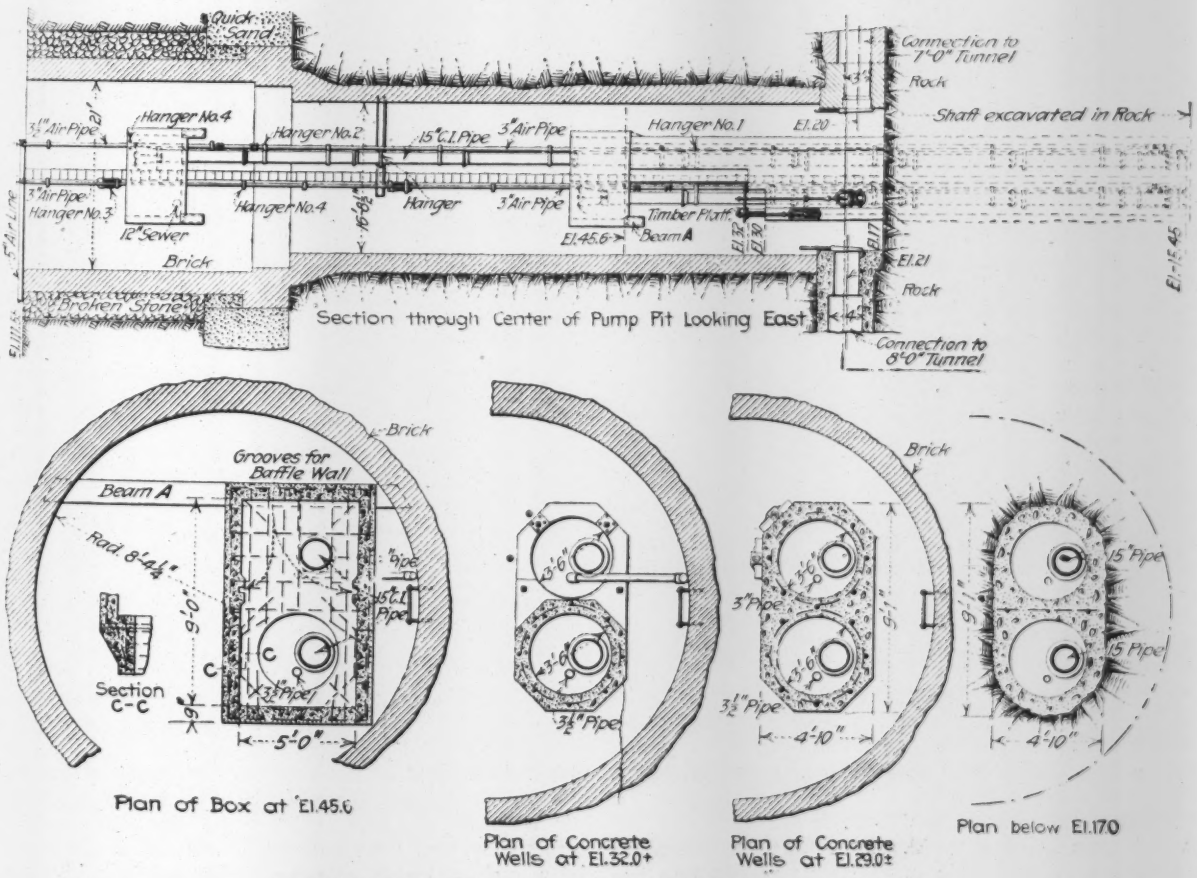
By Edward E. Wall
Water Commissioner, Department of Public Utilities, St. Lous, Mo.

When the intake tower and tunnel of the St. Louis water-works was built at the Chain of Rocks more than 25 years ago, the tunnel was connected at the river bank with a pump-pit shaft constructed for the purpose of installing at some future date pumps for unwatering the tunnel. It was decided at that time not to install any pumping machinery in this shaft. This was a wise decision, for it is probable that any pumps designed and constructed at that time would have proved entirely inadequate for the purpose.

About 10 years ago the great difficulty in obtaining a sufficient supply of water through this tunnel at seasons of low water gave rise to the belief that the tunnel was in some way obstructed. Also, the serious trouble arising each winter from the great quantity of floating and frazil ice coming into the suction well of the pump gave color to the theory advanced by someone that there was a break in the tunnel through which the river water flowed without control. There was a story circulated that at the time the tunnel was built an enormous leak occurred in the roof which the builders were unable to stop and which continued until the tunnel was completed. How they managed to finish the tunnel with this tremendous leakage no one seemed to be able to explain.

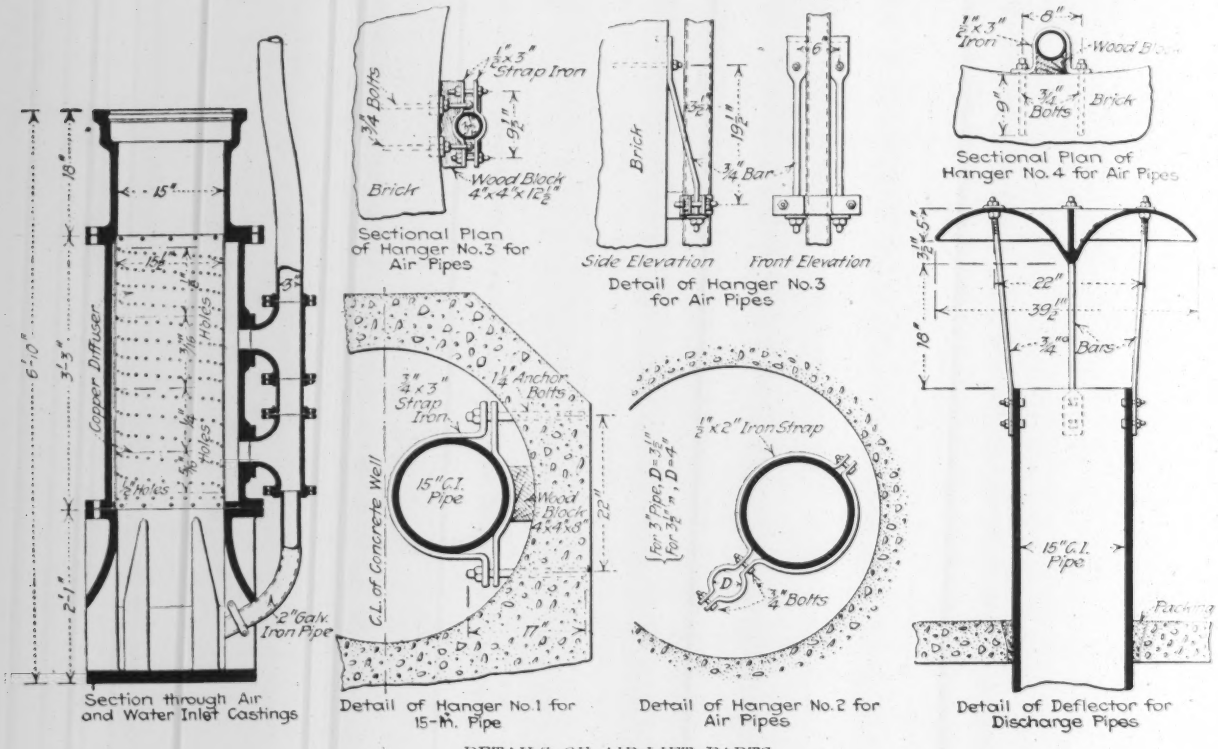
In 1911 it was decided to make a serious attempt to unwater this tunnel. An 8-in. pump was purchased and installed, but failed at any time to pump the guaranteed quantity of water, and after the valves had repeatedly given way under the maximum head of 100 ft., one of the cylinders cracked. The cylinder was welded and the valves were reconstructed, and repeated attempts were made to pump out the tunnel. The pump was unable to stand up under the 100-ft. head and drain the tunnel. It was then decided to install in this shaft a motor-driven centrifugal pump, completed in 1913.

In building a new intake and tunnel, which was completed in 1915, a connection was made to the same pump-pit shaft so that the new tunnel might also be unwatered by the same motor-driven centrifugal pump. The capacity of the pump was 4200 gal. per minute, with maximum lift of 84 ft., diameter of suction 12 in., diameter of discharge 12 in., speed 1200 r.p.m., efficiency 70 per cent, horsepower required for this duty, 117. The pump was mounted on a common bedplate with the driving motor and connected by means of a flexible coupling. The pump unit complete was mounted on an elevator platform which was lowered and raised by means of a hand-operated windlass. The discharge from the pump was connected to a 12-in. stationary discharge pipe at intervals of 12 ft. from El. 34 to 94, by means of a flexible hose about 5 ft. in length.



PIPING ARRANGEMENT OF TWO-STAGE AIR LIFT AT ST. LOUIS

(Upper drawing shows section through shaft. Rotate page to bring shaft into the vertical.)



DETAILS OF AIR-LIFT PARTS

The difficulties experienced in operating this pump were found to be as follows:

1. A force of 10 or 12 men was required to raise or lower the pump all of the time when the pump was below the elevation of the river.

2. It was found impossible to open the gate in the pump pit leading to the tunnels to be unwatered and lower the pump to the next connection beneath, before the water would rise in the well. In the last six years the motor was drowned three times.

3. If the gate was kept closed until the well was unwatered it was a very difficult operation to open the gate against the head of water.

In the autumn of 1916 the well was pumped out and the gate was opened to the new tunnel and, because of difficulties in operating the gates, connecting and disconnecting the pump discharge, temporary breakdowns, etc., it was seven days before the new tunnel was unwatered. During the same season an attempt was made to unwater the old tunnel, and after seven or eight hours' work the water was only 10 ft. lower than the water in the river, and the idea of unwatering the old tunnel with this pump was abandoned. The discharge at this time was found to be 2200 gal. per minute, the falling off in capacity being due to the wearing of the impellers and the slowing up of the motor due to changes in the winding.

In 1917 various schemes were proposed for unwatering the tunnels; among them was an air-lift pump. In 1918 a design of a two-stage air-lift pump was made with a capacity of 3000 to 4000 gal. per minute at a maximum head of 76 feet.

The first lift was from El. 22 to El. 49.6, and the second from El. 48.6 to El. 98. A 55% submergence was decided upon. This submergence required an excavation in the bottom of the present pump-pit shaft 32.5 ft. deep and the building of two 42-in. concrete wells from the bottom of the excavation to the bottom of the overflow boxes, at El. 45.6 and 94, respectively.

The work was done in January, February and March of this year. Fifteen-inch bell-and-spigot discharge pipes were placed in these wells, and special footpieces and air diffuser were provided. The air is carried through a 3- and 3½-in. pipe to the first and second lifts, respectively. These pipes were connected to a 5-in. air line about 550 ft. in length leading to an air compressor in the boiler room.

The estimated air required for 3000 gal. for both stages was 1950 cu. ft. per minute. The compressor used for this work was a compound machine having a piston displacement of 2450 cu. ft. per minute acting as a two-stage compressor and 3333 cu. ft. per minute acting as a twin single-stage compressor at 100 revolutions per minute.

The cost of the air-lift pump and installation are as follows:

Air compressor	$4,215.92
Erecting	899.41
Pipe line and laying	1,376.89
Shaft excavation	2,389.11
Concrete wells	3,351.80
Building	594.05
Cast-iron pipe, etc.	590.62
Miscellaneous	753.44
Total	$14,171.24

During the first week of August the new tunnel was unwatered in seven hours. On Aug. 30 the gates were closed at the ends of the old tunnel and the air pump was started, and in six hours the tunnel was dry for the first time since it was built. The operating of the air-lift pump was very satisfactory. The flow of water was steady, and the absence of a gush of air, followed by a gush of water, as usually observed in a high-lift pump, was gratifying. This condition was always main-

tained until the water was almost exhausted and the flow of water to the pump became much less than the capacity of the air lift, when the gushes of air and water commenced.

An examination of the old tunnel proved it to be in excellent condition, the fabled leak being nonexistent and all fancied obstruction of no consequence.

The air-lift pump was designed and built under the general direction of the water commissioner, the details of design and construction being under the direct charge of C. M. Daily, engineer-in-charge supply and purifying section.

Utilizing Imhoff Sludge on Land at Plainfield Sewage-Works

By John R. Downes

Superintendent, Plainfield, North Plainfield and Dunellen Joint Sewage Disposal Works, Bound Brook, N. J.

THE possibilities of recovering the "Economic Values in Sewage and Sewage Sludge" as discussed by Raymond Wells in *Engineering News-Record*, Nov. 27-Dec. 4, 1919, p. 948, may be summed up as follows: "Commercial recovery of the byproducts may be possible on a self-sustaining basis where the population is over 150,000 and the nitrogen in the sludge is over 3 per cent with 25 per cent of fats in such condition as to be amenable to treatment. For the small, isolated plant only the most direct recovery of the fertilizer value, with total disregard for the fats, seems practical. The writer believes that at the Joint Sewage Disposal Plant of Plainfield, North Plainfield and Dunellen, N. J., such recovery has been reduced to its simplest terms—by growing crops directly on the sludge. By this means oats and corn have been raised as described in the following paragraphs, which also give the methods of applying the sludge to the land.

A particularly favorable opportunity to determine the actual value of the sludge was afforded by the availability of a piece of land which had been stripped in grading, and on which by experiment it was found that nothing would grow. The land ran from clear sand to gravelly sand and soft red shale.

This piece of land was liberally coated with "Imhoff" tank sludge from the local plant. About forty one-horse, one-ton, loads of spadable (75 per cent moisture) sludge per acre was used the first year and 42 bu. of oats was raised. The second year, with three tons of sludge per acre, placed in the hills only, 50 bu. of corn was raised.

Since the land had no crop value whatever, we may figure the value of the sludge as follows: 40 tons of sludge broadcast the first year and three tons in the hills the second year made a total of 43 tons of sludge on which was raised 42 bu. of oats and 50 bu. of corn. At present (January, 1920) market quotations the crops would be worth $95.90 and to produce them at the present labor cost of $0.45 per hour would cost $51.80, leaving $44.10 as the total gross yield value of the 43 tons of sludge, or $1.02 as the value of a ton of sludge delivered in the field and spread. Delivery and spreading at the center of our disposal area, ½ mile from the drying beds, costs $0.45 a ton, leaving the net yield value of the sludge $0.57 a ton.

With our sandy soil and our production of approximately 300 tons of sludge a year per 1,000,000 gal. daily flow of sewage, this method of disposal requires between 20 and 25 acres of tillable land per 1,000,000 gal. daily capacity. One-third of this is idle to receive sludge, one-third is in crops on sludge one year old and one-third on crops on sludge two years old. The land will apparently stand a new coat of sludge every third year.

The aim of the works manager is to get his sludge out of the way as quickly and economically as possible and with the least amount of odor. This, as well as the recovery of any fertilizer value in the sludge, is met by direct cropping.

At the present moment we think that the best method of handling our sludge is the one practiced, as follows: A broad stone fork with square tines spaced ¾ in. apart is used for removing the sludge from the surface of the stone drying bed. When the 2-yd. manure spreader is filled, the tractor hauls it to the field, the gear is thrown in, the load spread and the return trip made without stopping. After a strip across the field has been covered, a little time is allowed for it to dry slightly on the surface, so that it will not be too slippery for the tractor, then it is turned under with the gang plow.

At current prices for labor, gasoline, etc., it costs $0.45 per cubic yard to dispose of the sludge in this manner. This figure covers upkeep and repair of tractor. As compared with our former method of hauling by one-horse dump wagon, and spreading by hand, the difference in cost is shown, by careful analyses, to be exactly that of spreading by hand, $0.11 per cubic yard. There is the great additional advantage, however, that the sludge is entirely out of the way, and cannot produce odors as it does when exposed in heaps, despite all theory to the contrary. Also the labor problem is much more easily handled, since spreading the sludge by hand is one thing to which the laborers object.

Up to the point of covering the sludge with the plow the operation is clearly a sludge disposal charge. Even beyond this point it is proper to charge the cost of cropping the land to sludge disposal, since removing the nitrogen and humus from the soil in preparation for the next dose of sludge is an essential disposal problem. Furthermore, it is essential to keep down weeds for the sake of appearances. This can be done by cropping.

The screenings from the Riensch-Wurl screen are also handled in a very satisfactory manner by means of the caterpillar tractor and manure spreader. The screenings are retained for 24 hours in a tip dump body so balanced that, when loaded, it just tips back on removing the latch. The impact of the sliding body of screenings against the front end board of the spreader, causes the latter to move forward on its concrete runway so that loading is both even and complete.

I am often asked as to the comparative value of the screenings and the tank sludge as fertilizer. We have not made this comparison for the reason that we find it convenient to cover the screenings with one or more loads of sludge before plowing under.

The experiment has given data on the actual effort required to raise a bushel of corn or oats in man-hours which may interest some in this day of fictitious prices. On the basis of 50 bu., of corn per acre, it required 1.56 man-hours actual labor to produce 1 bu. plowing to husking included. Gasoline equal to 0.04 man-hours and the use of a horse for cultivation equal in value to 0.06 man-hours makes a total of 1.66 man-hours. Oats, plowing to threshing included, required 0.76 man-hours per bushel. What a blissful world it would be if prices could be reduced to this basic relation between human effort and the production of the staff of life!

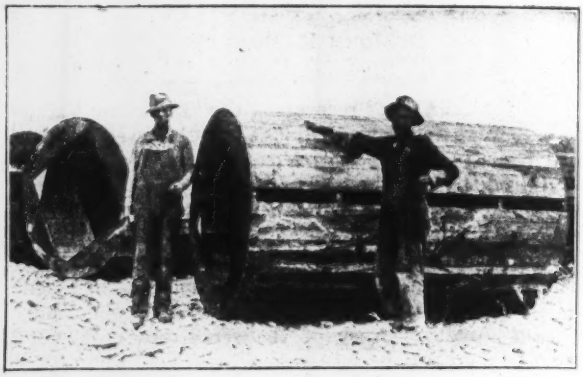
Design and Construction of Notus Canal Inverted Siphon

Seepage Water Head Saved by Warped-Surface Inlet and Outlet — Water Drained From Trench Each Side of Invert Form

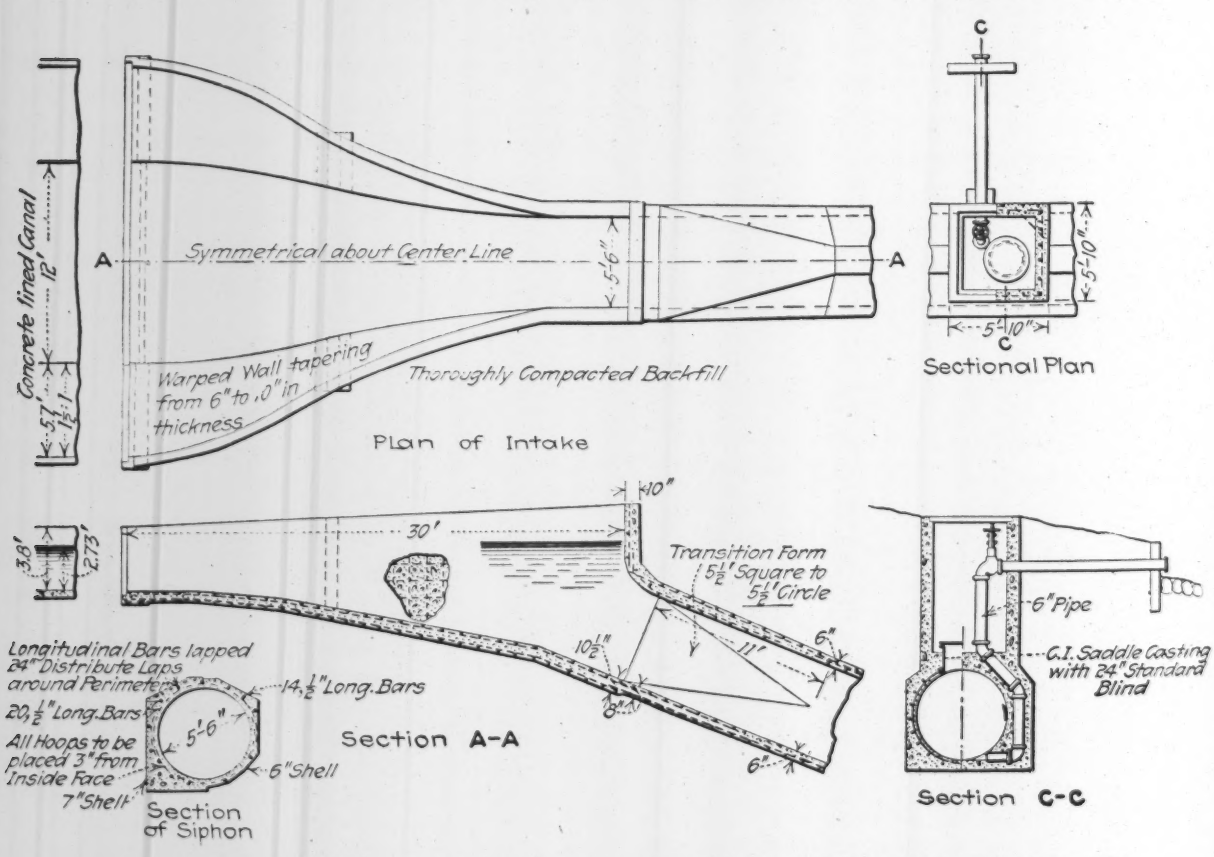
SEEPAGE water collected from one part of the Boise project of the U. S. Reclamation Service near Caldwell, Idaho, is to be conveyed by the Notus Canal 25 mi. to 6,000 acres in the first unit of the Black Canyon Irrigation District. On the line of the canal a reinforced-concrete inverted siphon 2,000 ft. long with a capacity of 120 sec.-ft. will carry the water beneath the Boise River.

Seepage water by Idaho law belongs to the original divertor and may be reused or resold by him provided he does not let it get back into a natural river course. The river bed, therefore, is not utilized to carry the water to lands below, but the siphon carries it onto bench land available on the opposite side from which it is collected. Construction methods are the chief features of the work, but the warped surfaces in the siphon inlet and outlet to prevent loss of head deserve notice.

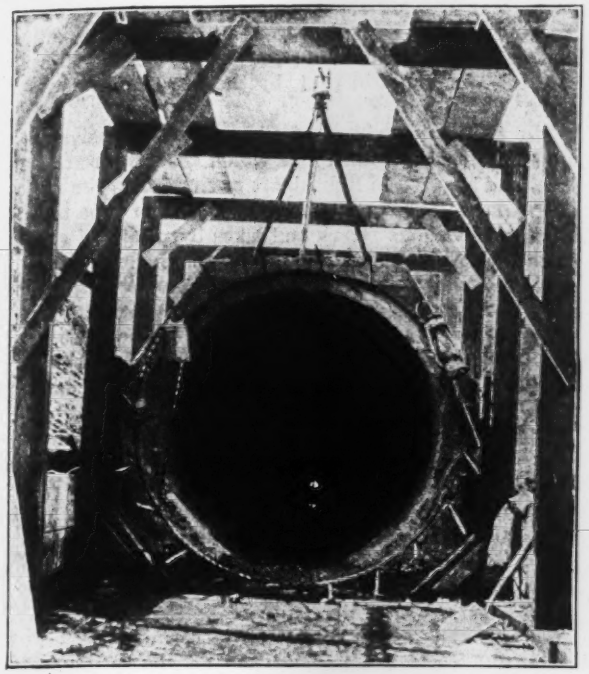
Above and below the siphon the hydraulic properties of the canal are as follows: $r = 2.01$; $n = 0.015$; $s = 0.0003$; $A = 43.94$; $v = 2.73$; $Q = 120$. For the siphon the velocity was increased to 5.05, the area decreased to 23.76 and correspondingly $r = 1.375$; $n = 0.014$ and $s = 0.00144$. The siphon invert at the lowest point is 66 ft. below the hydraulic gradient of the canal, but low water in the river will always reduce the head by at least 8 ft., making the net pressure head 58 ft. For 600 ft. under the river channel proper a 7-in. shell was specified, and for the remainder a 6-in. shell. A wasteway is provided just before the line rises from the flood plane of the river to the outlet, and a manhole with blank flange for pumping out the siphon is located at the lowest point near the river. Details of the inlet and typical cross-sections are shown in the drawing. The inlet is 7 ft. shorter than the outlet, since the canal above the siphon is in lined section having a 12-ft. bottom width, whereas below the outlet the canal gradually expands to an earth section having a 16-ft. bottom width.



INNER FORMS OR DRUMS FOR SIPHON
A 4-in. strip was left out of the bottom of each drum



DETAILS OF REINFORCED-CONCRETE SIPHON ON NOTUS CANAL, BOISE RECLAMATION PROJECT



FORM BENTS USED ON NOTUS SIPHON

As the summer of 1919 was the dryest season of record, no rain having fallen for 155 days, the river was nearly dry and the trench through the extremely porous gravel flood plane through which the siphon was laid was excavated without difficulty. A small dragline outfit mounted on multipedal tractors operating a ½-yd. bucket, did the major portion of the work.

Inner forms consisted of drums 8 ft. long, made in four sections and set after the reinforcing steel and outside bents had been placed. The drums were blocked up from the bottom, wedges being placed between the forms and the steel to give the proper spacing. Support from the top was afforded by wire to the top crosspiece of the bents. The blocking below was knocked out after concreting commenced. To insure getting concrete into the whole of the invert, since the section was all deposited at one time, a 4-in. strip was left out of the bottom of the drums through which the concrete would rise. When that occurred a strip was nailed over the opening. The extra inch of concrete was trimmed off when the forms were removed, usually within 10 days after depositing.

Bents for the outside forms were spaced 5 ft. 4 in. apart and consisted of 4 x 6-in. uprights with 2 x 6-in. cross-pieces erected on 4 x 6-in. sills separated by 2 x 6-in. cross sills. Planks on the outside of the uprights enabled the gravel backfill to be carried that high and assisted in holding the foot of the uprights against the pressure of the wet concrete. An absolutely dry bottom was not feasible, without an expensive underdrain, so channels were provided on each side by nailing 2-in. planks to inclined braces at the foot of the uprights. These channels were so effective that the water was hardly colored by cement being washed out from the invert concrete. Inspection of several hundred feet of the completed siphon by a representative of the *Engineering News-Record* disclosed a few honeycombed spots and a smooth job inside.

The bents and steel were erected ahead of the setting of 8 or 10 drums. The latter were easily placed by three men, this being the same crew that erected the bents. Bags of cobbles placed on top of the bents prevented their floating. The drums were reused five to seven times. Progress was 66 to 110 ft. of completed section per day with a crew of 14 men.

Two pumps, an 8-in. and a 5-in., were all that was necessary to keep down the water. Pumps and the concrete mixer were motor driven from a power line conveniently passing the outlet end.

The siphon was built by a day labor force under the general direction of J. B. Bond, project manager, with G. H. Hogue as engineer in charge and C. A. Williams as superintendent of construction.

Resurfacing an Old Brick Road

By Edward Stingel
Civil Engineer, New Philadelphia, Ohio

A METHOD used in resurfacing an old brick road in a county having mostly hard-surface roads is here described. The first road to be built in Tuscarawas County, Ohio, by the State Highway Department, was 1.30 mi. of the New Philadelphia-West Lafayette intercounty highway. The road was constructed in the summer of 1907, and at a cost of $13,000, and the type was sand-filled brick on a rolled gravel base retained with 5-in. curbs. The slab had an over-all width of 14 ft.

Instead of using No. 1 pavers No. 2 pavers were used; which proved too soft to withstand the heavy traffic passing over the road. After a number of year's service the road developed considerable roughness and later wore into holes; finally, in 1918, it was thought advisable by the maintenance bureau of the State Highway Department to resurface it. Two methods of repair were considered: (1) laying a new brick surface on a thin mortar base over the old brick surface; (2) resurfacing with plain concrete. After a careful review of the condition of the old road, costs, desired durability, ease and speed of construction, etc., it was concluded to build a concrete pavement over the old brick surface to a minimum thickness of 7 in. While this thickness may be excessive it was thought best to err, if at all, on the side of safety. The old brick were removed at bridge approaches and at the ends to meet the old grades, otherwise nothing was done to the old brick surface other than cleaning with brooms.

The concrete was mixed in the proportion of one sack of cement to 1½ cu.ft. of fine aggregate, and not to exceed 3 cu. ft. of coarse aggregate. After the concrete was placed and tamped it was rolled with a metal roller 6 ft. long, 10 in. in diameter, and weighing 70 lb. The surface was then finished with a rubber belt 8 in. wide.

The sand and gravel were shipped from a commercial plant. The local gravel, as a rule, carries too much native sandstone to pass the state highway specifications which allow a loss by abrasion of not to exceed 12 per cent for this class of work.

The work was done by Springer & Rogers of New Philadelphia, Ohio, at a contract price of $25,000. An examination of the cost of the original road and that of rebuilding shows that it was uneconomical to use the No. 2 pavers to save first cost. The slight extra expenditure necessary to have secured No. 1 pavers, perhaps, would have doubled the life of the road and thereby reduced greatly the maintenance costs.

Notes from Foreign Fields

Engineering in North China

By Donald F. McLeod
Professor of Railway Engineering, Chinese Government Engineering College, Tangshan, North China

ENGINEERING construction in North China, outside of a small amount of work on railways, is confined to the cities and ports. There are no factory towns in the country, no isolated residences, no electric interurban railways, no water-power plants, or hydro-electric plants with electric-transmission towers stalking across the face of the country, as in America, no telephone poles along the country roads, no bond-issue roads, no automobiles, or motor trucks, except in the large cities. There are no ordinary highways of gravel, macadam, concrete, brick, etc.—not even sand-clay roads, or earth roads properly built. There are, however, some modern pavements in the cities.

Such roads as there are, consist of mere trails, absolutely ungraded, except where the surface drainage has followed the course of the road and produced sunken-road effects through hundreds of years of traffic. In spite of the generally rough, and rutted condition of such roads, there is a large amount of traffic on them. The typical, and practically the only, wheeled vehicle is a kind of cart, the axle of which is, generally, attached rigidly to the two wheels and turns with them. These vehicles carry such heavy loads, on such narrow tires, and the traffic is of such concentration, that any road surface, except a first-class pavement, would be destroyed by them in a few years. Grading the roads, without protecting newly filled places with a good wearing surface, would be wasted effort. The cart wheels would soon cut ruts so deep that the axles would drag on the ground.

Highway Maintenance

Drainage details, a *sine qua non* of the roads of Eastern America and the Middle West, are missing on the roads of North China, and, for the most part, do not appear to be needed. There are no fall rains—only a few tenths of an inch of moisture in winter, in the form of snow and there are no spring rains. During three winters in this country (Province of Chi Li), the writer has not seen enough water to cause pools on the flattest surfaces. Occasionally after a heavy summer thunderstorm, rain water stands on the ground for a few hours, but in most localities it soon disappears.

The comparative absence of water accounts for the wonderful service given by roads on which, as far as the writer can find out, no maintenance work is ever done. An appearance of maintenance work in progress is sometimes given by Chinese farmers working at the margin of the road with shovels. These shrewd workers, however, are "looking out for number one" in characteristic Chinese fashion. The work they do consists of the digging of a series of pits about 2 ft. deep, about every 3 ft., paralleling the margin of the road. These little pits are quite effective in confining traffic to the road itself, and keeping it from damaging the winter wheat.

The comparative lack of rail communication in China may be illustrated by saying that New York State, on the Chinese basis, would have a total of only 122 miles of railway, if supplied with railways on the basis of its area, China having only about 10,000 miles of railway on a total area of 4,000,000 sq. miles, or one mile of railway per 400 sq. miles of area. Since there are no highways, in an American sense, the lack of railways has to be made up, in part, by the use of inland waterways.

The eastern provinces of China have extensive areas of gently sloping country in which the rivers are sluggish, and adapted to light-draft navigation. The system of inland waterways has been improved in time past by linking up various rivers and lakes by means of shallow canals. However, maintenance on these canals has been neglected, and some of them have become so silted up as to be unusable. Often those in use have so little water supply that even the very light-draft Chinese boats get stranded in the shallower places, and the boatmen have to resort to scraping together low temporary dams to raise the water level.

The Chinese junks used on the canals are comparatively long and narrow. The ones used on the larger canals and rivers draw from 4 to 6 ft. when loaded. They are propelled, as far as possible, by sails. The boatmen show considerable skill in unstepping and stepping the masts where bridges cross the canal. Using a 30-ft. gin pole, for example, they quickly erect a 50-ft. mast. When the wind is light, or unfavorable, the junk-men peel off what little clothing they wear, swim and wade ashore, and pull on the towing ropes. These naked boatmen are the only draught animals used in propelling canal boats, as far as the writer has observed. There are horses in the country, but they are used mostly by soldiers. The numerous mules and donkeys are used mostly as farm or pack animals.

There are no locks on Chinese canals, in the sense in which an American regards a lock. There are different levels of the water, however, controlled by dams. In these dams there are openings, controlled by stop-logs, wide enough to admit a canal boat. When a boat comes to one of these dams, and the next stretch of canal is at a higher level, the stop logs are taken out and the boat hauled through the opening over the out-rushing water, by means of capstans and ropes.

Canal Transportation

No doubt, as Charles Whiting Baker so ably shows, in *Engineering News-Record* of Jan. 1, shallow inland waterways are uneconomical in a country like America, where rail communication has been brought to such a high state of efficiency. But in China the railways are inadequate, and highways non-existent. Furthermore, labor is cheap. A canal boat of 6 tons' capacity, with crew of three, costs only about $2.40 for labor.

To show that railways do not take the place of canals in China the case of a canal paralleling closely a line of railway may be cited. This is the canal, about 70 miles in length, paralleling the Peking-Mukden Ry. from Tientsin to a point about 7 miles distant from Tangshan. The freight rates on this railway are so high and the scarcity of rolling stock is such that, during the open season of the canal, a great deal of coal is carried from the mines at Tangshan over the 7 miles required to reach the canal. There it is transhipped by hand labor to canal boats. The principal return cargo is rice. Another outward-bound cargo from Tangshan is a local product made of glazed earthenware, known as kangs. The material of which these kangs, a variety of large, vase-like container, is composed closely resembles that of which shale paving blocks are made in America. A

large kang holds about one and a half times as much as an American flour barrel. It is decay-proof and water-tight and from the sanitary standpoint is superior to a flour barrel, a container unknown in North China. However, it is not used for the transport of its contents, since a kang of a barrel-and-a-half capacity weighs about 150 lb.

The Grand Canal is of particular interest at the present time, for it is being studied by American engineers with a view to its rehabilitation. The American International Corporation is in charge of the work. The consulting engineer is John R. Freeman and the chief engineer, Joseph Ripley.

The Grand Canal extends from Hangchow to Tientsin, and thence by a small river to Peking, a total distance of about 800 miles. It is somewhat longer than the water route from Cincinnati to New Orleans, along the Ohio and Mississippi. Its course roughly parallels the coast, and crosses two large rivers, the Hoang Ho and the Yangtse Kiang. Parts of it were put in operation thousands of years ago.

Four years ago the sum of $6,000,000 was made available for the improvement. The surveys have been in progress about two years. When the $6,000,000 was first available it was equivalent to about $12,000,000 in Chinese money, which would have gone much farther in canal construction then than the same amount of Chinese money now, as the cost of materials and wages has increased considerably since then. It can be concluded that if the $6,000,000 were put into Chinese money at the present rates of exchange (Feb. 17, 1920), in which event only about $5,500,000 Chinese money could be made available, the amount of construction work and material which could be put into the canal would be much less than half of what could be done when the money was secured.

The work of the field surveys for the improvement of the Grand Canal has been hindered by the apparent necessity of having each field party accompanied by a guard of soldiers, as protection against bandits. The experience of the past few years has given justification for the maintenance of such a guard. The files of *Engineering News-Record* contain an account of George Allen Kyle's enforced sojourn of several months with the bandits who captured him in Honan. A large ransom had to be paid for his release. On the Lung Hai Ry. in the Hoang Ho Valley, not far from the route of the Grand Canal, bandits two years ago stopped a passenger train by putting a pile of stones on the track. All of the passengers were robbed, and several of them killed. After this the Lung Hai Ry. schedules were revised so that trains should pass through this region only by daylight. At the present writing an American Y. M. C. A. missionary has been in the hands of bandits for two months in the province of Yunnan.

The engineering problems connected with the modernizing of the Grand Canal are of considerable difficulty. The principal ones are the protection of the canal from damage by floods and the provision of sufficient water for the section north of the Hoang Ho in dry seasons.

One of the sources of flood is the western slopes of the Shantung mountains. Another is the Hoang Ho. As regards the former, such gagings of the Shantung stream as are available indicate that the quantity of water to be discharged is very great, being the run-off from an area of about 9,000 sq. miles, at about 28 sec.-ft. per square mile, a total of about 250,000 sec.-ft. As the canal occupies the natural outlet for all the streams flowing westerly from the Shantung mountains, this enormous flood flow must be discharged by the canal itself and such overflow channels as are acquired by such a tremendous discharge.

The streams which give this flood flow are those which must supply the northern section of the canal in dry seasons. In former times the problem was easier, as the Hoang Ho discharged into the sea south of the Shantung peninsula. Now, however, the Hoang Ho discharges into the sea north of the Shantung peninsula. Consequently the feeder for the northern section must cross the Hoang Ho. It is proposed to make the crossing by means of tunnels under the river. The water of the Hoang Ho itself can not be used to supply the canal, as it contains too much silt in suspension and would soon fill the canal with mud.

The extreme flood discharge of the Hoang Ho is not known. The engineers making the present studies for the improvement of the canal were fortunate enough to have an opportunity of gaging the highest stage of water which has occurred in the past ten years. A lock will be necessary at each side of the river where the canal crosses, and a system of guide ropes designed so that boats crossing will not be carried away by the swift current of the Hoang Ho. Provided the Hoang Ho can be confined to its present course the task of maintaining the canal will be easier. However, the Hoang Ho has occupied ten different locations for the 400 miles from the mountains of the interior and the sea during recorded history. In the last move the change in the location of the estuary was about 260 miles. For 200 miles above the estuary the river is diked on both sides, and, for the greater part of this distance, double diked on both sides. The river is now under control, apparently, as far as channel movement is concerned, for the last move took place about a hundred years before the discovery of America.

DONALD F. MCLEOD

Tangshan, North China, Feb. 19, 1920.

Comparing Notched-Bar Impact Tests

Studies of the results of notched-bar impact tests by W. C. Unwin lead him to conclude (*Engineering* of Sept. 12, 1919, p. 329) that the common practice of comparing tests by reducing their results to the basis of rupture work expended per unit volume is seriously faulty. No consistent way of comparing small and large bars—as, for example, the 10 x 10-mm. testpiece with the often used 30 x 30-mm. testpiece—is in existence. The unsatisfactoriness of all existing methods of reduction is brought out by Dr. Unwin through the calculation of the mean errors of sets of observations comprising different sizes of bars, these mean errors being found to be erratic and excessive in amounts. Dr. Unwin has been able to reduce the mean error considerably by rating the rupture work on the basis of the five-fourths power of the area, or in another case, on the basis of the product of breadth of testpiece by the three-halves power of the depth. Believing that by further trial in the same direction a satisfactory method of rating impact-test results may be discovered, he suggests that impact tests be reduced to the basis of work divided by the *n*th power of the area, and that the value of the exponent *n* be determined from extensive new series of impact tests carried out with great care.

Altitude Observation of the Sun for Meridian

By John D. Adams
Office of the United States Surveyor General, Phoenix, Ariz.

DURING the number of years in which the writer has been connected with the execution of the public land system of surveys, he has been impressed with the lack of a working familiarity, on the part of civil engineers in general practice, with the necessary procedure for the quick and accurate determination of meridian.

The reason for this, no doubt, lies in the fact that this procedure is avoided as much as possible, on account of the fact that it is so frequently inconvenient, as in the case of an observation on Polaris in the chilly hours of the early morn, or is uncertain when use is made of a solar attachment that has not been tested in months. But Polaris and the mechanical solar are fortunately not our only resources, as there still remains the "direct solar," or observation of the sun through the main telescope of the instrument, a method of determining the meridian that has many advantages to the man who wishes to do his work in the daytime, to do it well and get out of the field as soon as possible.

The hesitancy with which many engineers undertake this form of observation is probably due to the fact that the instrumental readings must pass through a trigonometric formula before the azimuth of the sun can be ascertained, but often this need not be done until one returns to the office, when a set of logarithmic functions will dispose of the matter very quickly. The slight mathematical work is surely no valid objection—certainly not enough to counterbalance the many advantages. Here only the few simple adjustments of the main telescope are involved, and even then any reasonable errors may be eliminated by reversing, whereas the solar attachment affords no such remedy and at the same time involves a number of adjustments, the disarrangement of any one of which may render the observation worthless. In the case of the direct solar we do mathematically what the solar attachment does mechanically, and what it may do very satisfactorily if it is frequently tested during the morning and afternoon hours on a meridian determined from Polaris.

Formula—Probably the most convenient formula for the determination of meridian from observation of the sun's altitude is:

$$\cos \text{azimuth} = \frac{\text{sun's declination}}{\cos \text{latitude} \times \cos \text{altitude}} = \tan \text{latitude} \times \tan \text{altitude}.$$

It must be borne in mind that south declinations (from about Sept. 21 to Mar. 21) are negative in sign. If the algebraic sign of the result is negative, the sun's azimuth, so derived, is to be referred to the south point; if positive, to the north point.

Declination—To determine the declination one must have recourse to an ephemeris of the sun such as is put out by instrment makers or in a very superior form by the Government Printing Office, Washington, D. C., at a cost of 5c. In addition to solar data, this excellent publication gives the times, for every day in the year, of upper culmination and elongation of Polaris.

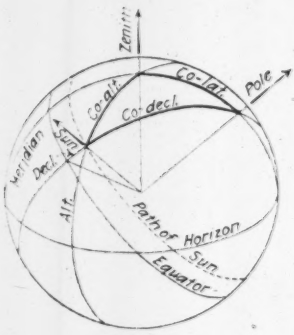


FIG. 1

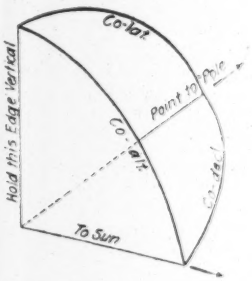


FIG. 2

In using the ephemeris it is only necessary to multiply the "difference for one hour" by the number of hours elapsed since Greenwich noon and add the result to the tabulated declination if the declinations are at that time of year increasing, or subtract it if the declinations are decreasing. The declination not being a matter of observation, no correction should be applied to it for refraction.

Local Mean Time Unnecessary

Time—As there is considerable misunderstanding in the matter of time, it should be stated that local mean time is not necessary for practical results. The reason why this is so may be better understood if one would conceive of the watch being set to Greenwich time, in which event it would only be necessary to consult it at the time of the observation and then multiply the hourly difference by the watch reading—that is, if the watch says it is 8 o'clock the multiplier will be 8. If the watch is set to 75° meridian time, the difference between it and Greenwich will be five hours, so that the values given in the tables will all take effect at 7 a.m. by such watch. Consider three watches accurately set, one for Greenwich, reading noon; one for standard time, reading 7 a.m.; and one for local mean time, reading 7: 30 a.m. If an observation is later made at 3:30 p.m. local mean time, then the standard watch will read 3 p.m. and the Greenwich 8 p.m. Making the necessary subtractions, we get identical results, or eight hours as the period of time elapsed since Greenwich noon.

Latitude—The latitude may be derived with sufficient accuracy from the topographic sheets of the Geological Survey, the General Land Office state maps, or, if the latitude of a nearby point is known, correction may be made by allowing 52 sec. per mile.

To make an independent field determination, altitude observation may be made on the sun at apparent noon, or upon Polaris at culmination. Simple and practical formulas for these observations may be found in the Standard Field Tables of the General Land Office, published by the Government Printing Office. This is a very compact and convenient publication of over 200 pages, and contains a great many valuable tables and formulas for the engineer.

Altitude—Before using the observed vertical angle of the sun in the formula, the correction for refraction (always subtractive) must be applied. The accompanying Table XX taken from the above mentioned publication, gives the various values, and is more comprehensive than those usually supplied.

TABLE XX. MEAN REFRACTIONS IN ZENITH DISTANCE.

Bar. = 29.6 Ins. Temp. = 50° F.

Apparent Altitude		Refraction		Apparent Altitude		Refraction		Apparent Altitude		Refraction	
°	′	′	″	°	′	′	″	°	′	′	″
7	30	6	53	12	0	4	25	25	2	3	
	40		45	12	30		15	26	1	58	
7	50		37	13	0	4	5	27		53	
8	0		30	13	30	3	56	28		48	
	10		22	14	0		47	29		44	
	20		15	14	30		39	30		40	
	30		8	15	0		32	32		32	
	40	6	2	15	30		25	34		25	
8	50	5	55	16	0		19	36		19	
9	0		49	16	30		13	38		14	
	10		43	17	0		7	40		9	
	20		38	17	30	3	1	42		4	
	30		32	18	0	2	56	44	1	0	
	40		26	18	30		51	46	0	56	
9	50		21	19	0		46	48		52	
10	0		16	19	30		42	50		48	
	20	5	6	20	0		37	55		40	
10	40	4	57	21	0		29	60		33	
11	0		48	22	0		22	65		27	
	20		40	23	0		15	70		21	
11	40		32	24	0		9	80		10	
12	0	4	25	25	0	2	3	90	0	0	

Procedure—To secure a meridian that will be accurate to the nearest minute and one that will serve as a basis to check the solar attachment, it is customary in the public land surveys to make a series of two or three sets of observations, direct and reversed. The sun is first observed, say, in the upper right limb, the altitude reading taken and the horizontal angle measured to any suitable reference point. The instrument is reversed and the process repeated with the sun in the lower left limb. A mean of each of the two pairs of readings is used in the formula. Similarly with the second and third sets, after which the mean of the resulting azimuths is taken as final.

With a table of logarithmic functions, the work involved is slight. Ordinarily, the difference in declination will be negligible during the time consumed in making the observations, so that values of sin decl. ÷ cos lat. and tan lat. will remain constant throughout the series.

A prismatic eyepiece is a great convenience for making the observation, particularly in the southern latitudes, but very good results may be obtained by letting the image fall on a white card.

Refinements—In very close work, especially in the spring and autumn when the declination is changing more rapidly, it is advisable to take into account the "equation of time' stated in the ephemeris, as the tabulated declinations are based on Greenwich apparent noon. Failure to do this, however, should in no case give a resulting declination more than about 12″ in error.

Modification of the correction for refraction may be made for high altitudes or unusual temperatures on the basis of Table XXI also taken from the Government publication.

TABLE XXI. COEFFICIENTS TO APPLY TO MEAN REFRACTIONS FOR VARIATIONS IN BAROMETER AND TEMPERATURE.

Barometer In.	Elevation Above Sea Level Ft.	Coefficient	Barometer In.	Elevation Above Sea Level, Ft.	Coefficient	Temperature (Fahr.) Deg.	Coefficient
30.5	—451	1.03	25.4	4,535	0.86	—24	1.17
30.2	—181	1.02	25.1	4,859	0.85	17	1.15
30.0	00	1.01	24.8	5,186	0.84	9	1.13
29.9	+ 91	1.01	24.5	5,518	0.83	0	1.11
29.6	366	1.00	24.2	5,854	0.82	+ 8	1.09
29.3	643	0.99	23.9	6,194	0.81	16	1.07
29.0	924	0.98	23.6	6,538	0.80	25	1.05
28.7	1,267	0.97	23.3	6,887	0.79	33	1.03
28.4	1,493	0.96	23.0	7,239	0.78	40	1.02
28.1	1,783	0.95	22.7	7,597	0.77	45	1.01
27.8	2,075	0.94	22.4	7,960	0.76	50	1.00
27.5	2,371	0.93	22.1	8,327	0.75	55	0.99
27.2	2,670	0.92	21.8	8,700	0.74	60	0.98
26.9	2,972	0.91	21.5	9,077	0.73	66	0.97
26.6	3,277	0.90	21.2	9,460	0.72	77	0.95
26.3	3,586	0.89	20.9	9,848	0.71	88	0.93
26.0	3,899	0.88	20.6	10,242	0.70	100	0.91
25.7	4,215	0.87	20.3	10,642	0.69	114	0.89
25.4	4,535	0.86	20.0	11,047	0.68	128	0.87

Any true refraction either in zenith or polar distance = tabulated refraction × coefficient for barometric pressure × coefficient for temperature.

The differences between the true and the tabulated refractions are generally small and generally negligible, excepting for the combined effect of low, apparent altitude of observation with high elevation above sea level or extremes of temperature.

An ultrarefinement may be made by correcting the vertical angle of the sun, or altitude reading, for parallax by adding 9″ cos altitude.

Demonstration of Formula—Those who have largely forgotten their spherical trigonometry and others who are interested in instruction work in the department of civil engineering may find the following proof of the formula for direct observation of interest, not only from the fact that the merest elements of place trigonometry are involved, but on account of the method employed as an aid to the ready visualization of spherical triangles.

In Fig. 1 is given the usual representation of the various arcs involved, and the problem is to solve the spherical triangle between the sun, pole and the zenith. Cut a circle of about 3-in. radius from a piece of stiff paper, and draw four radii so disposed that the intervening sectors will represent the co-altitude, co-altitude and co-declination, all as shown in Fig. 2, after which cut away the surplus material. Lightly score with the knife along the two radii marked "vertical' and "polar axis," and then bend until the result is as indicated in Fig. 3, when it will be apparent that we have an excellent model of the spherical triangle and the three involved planes.

Flatten out again, and place on it the various construction lines and symbols shown in Fig. 2, the truth of which will be evident to anyone with an elementary knowledge of the relation of sines, cosines and tangents. Attention may be drawn to the fact that when the co-latitude plane is placed flat on the table, the point X is vertically over Y. A few minutes' study with the diagram opened up and bent into shape will show that we have one value for the line X-Z as a whole and a value for each of its two parts, from which an equation may be instantly made, and this is the equation of the direct solar.

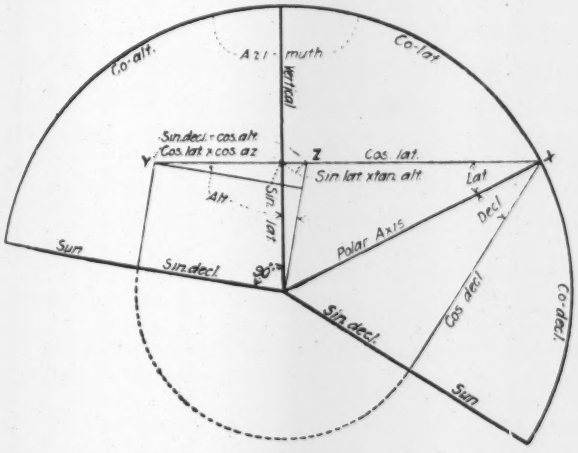


FIG. 2. HOW PRICE OF STIFF PAPER IS MARKED TO FORM MODEL OF SPHERICAL TRIANGLE

Railway Spreader Car Handles Heavy Materials

Dumped Iron Ore and Stripping Spread by Wings and Plows Pneumatically Operated on Car Pushed by Locomotive

IN DISPOSING of lean ore and the overburden or stripping on the open-cut mines of the Oliver Iron Mining Co., in Minnesota, the material is deposited in large spoil banks or fills, the ridges of material dumped from the cars being leveled by means of spreaders propelled by locomotives. For this service in handling specially heavy material a spreader car of exceptional strength and weight has been built recently and is shown by the accompanying illustrations. Its special features lie in matters of detail, the general design being similar to other machines of the same class used in this service and in railway construction and improvement.

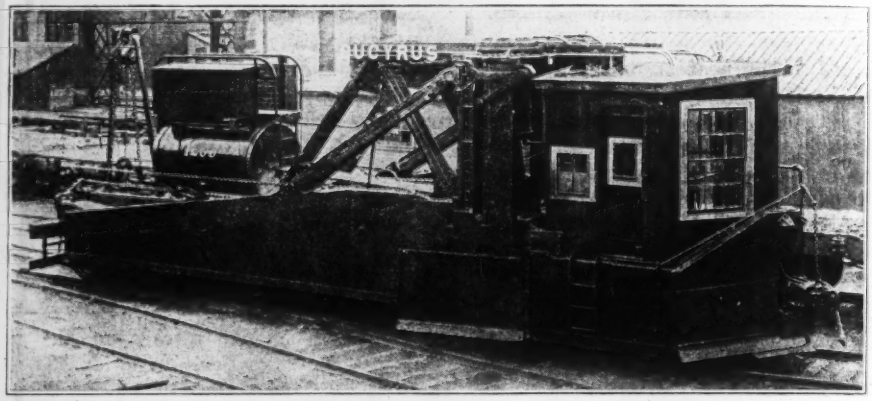


FIG. 1. SPREADER CAR FOR LEVELING DUMPS OF IRON ORE AND STRIPPING

As to the severe condition of the work done by this spreader car, it may be explained that the lean ore averages a weight of about 4,000 lb. per cu.yd., while the overburden averages about 3,200 lb. The latter consists of a mixture of sand, gravel and red clay; it contains a large percentage of boulders and any pieces that will pass through a 7-yd. dipper on a steam shovel are loaded into the cars. When these materials are frozen they are hard to handle except by a powerful spreader. Dump cars of 20-yd. and 30-yd. capacity are used, dumped by air under control from the locomotive.

Work is carried on day and night, about 200 cars being handled on each shift. Trains of five or six 20-yd. cars are handled by 64-in. standard-gage locomotives of the 0:6:0 class, having cylinders 19 x 26 in. and 42-ton tenders. An engine of the same type and weight, operates the new spreader car. With the spread of wing 22 ft. from center of track, the bank can be widened for 8 ft. before it is necessary to shift the track to the slope, while with lighter machines it has been necessary to move the track 4 ft. at a time. With the smaller machines, also, the dump cars are separated or spotted so as to make separate dumps to be spread, while the new machine spreads a continuous pile dumped by the entire train. This work is under the direction of M. H. Godfrey, district manager of the Oliver Mining Co.

The spreader consists essentially of a heavy steel car frame mounted on trucks and carrying at each side a pivoted wing, which can be swung out to any desired angle up to 45 deg. with the center line of the track, being braced in this position by a strut which transmits the thrust to the car frame when the wing encounters a pile of material to be leveled. The wing can be raised and lowered and can be inclined in a vertical plane for dressing the slopes of cuts. All these adjustments are effected by compressed air cylinders, the air supply being taken from a tank receiver connected to the train line.

Each main wing is 25 ft. long, made of three cast-steel plates, reinforced with a cast-steel angle on the bottom or cutting edge. The outer section is attached to the main part of the wing by dumb-bell clamps so designed that they will break and thus release the end of the wing if it should encounter an obstruction too heavy to be moved. In this way serious damage to the wing itself will be avoided. The heel of the wing is attached by pins to a casting which can be raised and lowered on vertical posts, and which has rollers bearing against these posts to facilitate movement. When in its horizontal position the wing has a vertical travel of 3 ft. 7 in., with the cutting edge 2 ft. below the head of the rail when in its lowest position. The width of spread is 12 to 22½ ft. from the rail to the outer end of the wing.

In a vertical plane the wing may be inclined to a maximum angle of 15½ deg. with the horizontal, and adjusted with its outer end from 1 ft. below to 7 ft. above the inner end. This adjustment is made by means of a belted telescopic joint in the diagonal tension member extending from the head of the guide post to the middle of the wing. To make this adjustment, the outer end of the wing is attached to the chain of a differential hoist on an A-frame at the rear of the car. The joint in the tension member is then disconnected and the wing raised by the hoist, pivoting on the main pin in the crosshead. When raised to the required angle, the telescopic joint is bolted up and the chain hoist then detached. The wing can be folded flat against the car, regardless of its inclination from the horizontal.

Operation of Spreader Wing

Initial movement of the wing is effected by the piston rod of a horizontal cylinder placed at right angles to the track. This acts also as an air buffer when the wing is folded back. With the wing thus pushed out, its further movement is effected by the wing brace or strut, which consists of a length of 9-in. heavy steel pipe having cast-steel fittings for a universal joint at each end. The joint at the rear end has a ball engaging a socket formed in a crosshead which travels on a guide with a movement of about 18 ft. This crosshead is operated by an endless chain passing over a sprocket

wheel the shaft of which is geared to a compressed air cylinder. The position of a movable stop, carrying locking dogs, determines the angle of the wing opening, and when the crosshead makes contact with this stop it locks automatically in position, so that the thrust is taken directly by the guide and car frame. After the movable stop is set for any desired width of spread, the wing can be closed and opened to this width from the cab.

An auxiliary wing is pivoted ahead of the main wing and has its rear end bearing against the latter. This prevents the plowed material from piling against the inner end of the wing or flowing over the track, while it also protects the hinge mechanism from being fouled by the material.

A front or pilot for clearing snow or loose material from the track is a special part of the equipment. It consists of two blades hinged to a post at the center line of the track and braced in position by struts. These blades can be adjusted by handle to form an ordinary nose or wedge plow, throwing the material to both sides, or to form a diagonal plow of 9½ ft. spread, throwing the material to either side. The plow has a vertical lift of 13½ in. on its guides, the flangers on the bottom edge being 2½ in. below the rail head with plow in its lowest position.

A cab at the forward end houses the operating mechanism, which consists mainly of a group of four valves controlling the air cylinders. Two valves provide for raising and lowering the two main wings, a third controls the power gear for operating the crossheads of the wing braces (these being operated independently of each other), while a fourth controls the raising and lowering of the forward plow.

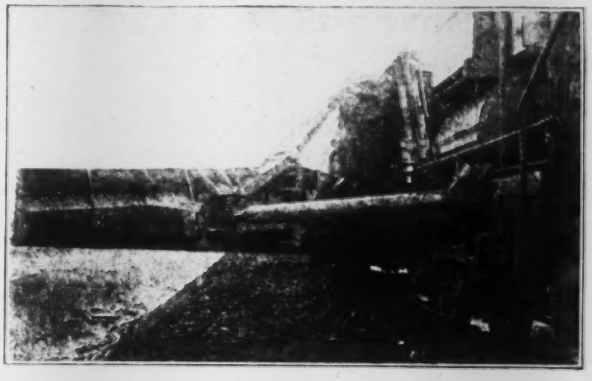


FIG. 2. CAST-STEEL SPREADER IS HELD BY ADJUSTABLE BRACE AND TENSION MEMBER

The machine, designed and built by the Bucyrus Co., is 45½ ft. long and weighs 68 tons. About 40 tons are concentrated on the front truck in order to hold the car down to its work and prevent it from being raised or derailed when the plow encounters heavy resistance. The equipment includes air brakes and automatic couplers, so that the car can be hauled in freight trains for transportation.

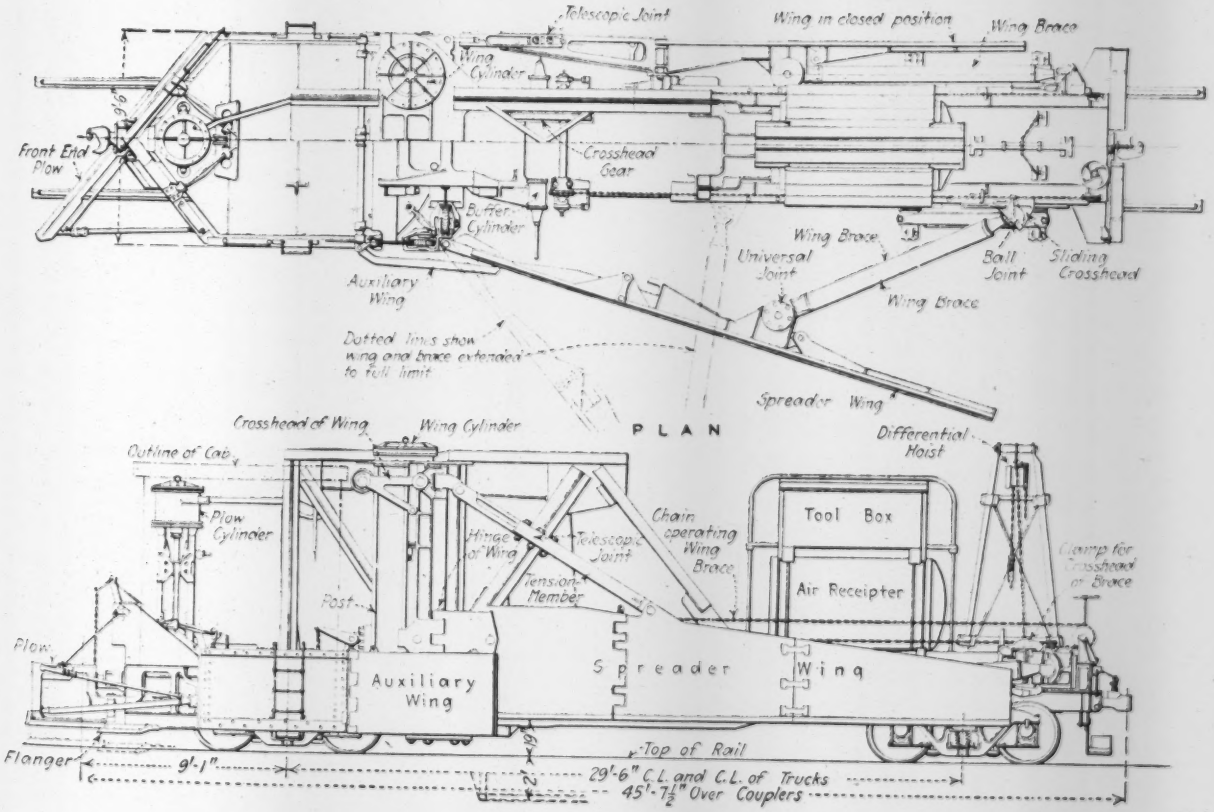


FIG. 3. MECHANISM OF PNEUMATICALLY OPERATED SPREADER CAR

Freighting with Motor Trucks on Kern River Project No. 3

Experience Gained in Delivering 28,000 Tons of Freight to California Job Over a 50-Mile Haul on Mountain Roads

WHEN the Southern California Edison Company early last year decided to rush construction on the hydro-electric development known as Kern River No. 3, the transportation problem presented itself first. The nearest railroad station was the little desert town of Caliente, 40 miles from construction headquarters, making the average haul to the several sites about 50 miles. The road was practically all up or down hill the grades ranging up to 16 per cent. The construction contemplated called for supplies and materials amounting to 35,000 tons. The first question was whether it would be desirable to build a railroad. Surveys and estimates of cost were made but it was finally decided that it would be more eco- -ical to use motor trucks.

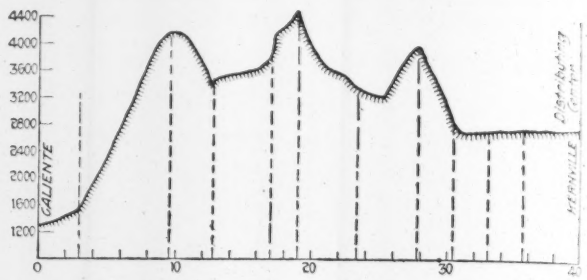
To begin operations the company simply called for privately owned trucks to come in and handle the freight at the best price they could quote. The freight movement had to be started promptly and the company was not yet ready to provide its own transporation. There was a ready response to this call and the the freighters charged $20 per ton for delivery to headquarters camp with stipulated prices for going beyond this distributing center. In order to control the situation and have first-hand information on costs, the company put on a few trucks of their own. Privately owned trucks then reduced their rate to $15 per ton.

After the company gained practical experience in handling the freight under local conditions it came to the conclusion that the net haulage costs should be still further reduced. A conference with the private truck owners was then called and the company offered them $10 a ton on a permanent basis, the company to do all loading and unloading and road maintenance. This figure was accepted.

Before the end of the summer the company had operating out of headquarters camp, 43 of its own trucks of 1 to 12-ton capacity. In addition, 52 privately owned trucks were regularly operating so that a total of 95 were employed continuously in handling through freight alone. During the winter season a smaller fleet was used. The tonnage hauled was 28,000.

In planning its own truck operations the company placed first importance on providing everything necessary in the way of spares and repair parts. Expert advice on mechanical troubles was made available and every endeavor was made to maintain the best possible service. A garage fully equipped with machine tools, hydraulic tire presses, etc., for the upkeep of rolling stock was located at Caliente.

Two elements found essential to successful maintenance were capable drivers and an effective system of inspection. The most satisfactory drivers were found to be those able to analyze trouble as it occurred on the road. Despite the most careful inspection system, it was reasoned, emergencies en route would be inevitable and the loss of time from this source would be an important matter. The careful handling of the trucks when they worked well and intelligence in



PROFILE, SHOWING ABSENCE OF LEVEL STRETCHES

emergencies was found to be well worth the difference in cost between good and indifferent drivers. A great convenience was the telephone line strung along the 50 miles of road with stations about 4 miles apart or as near this as convenient locations could be found. That is, stations were put, preferably, at the tops or near the bottom of the grades.

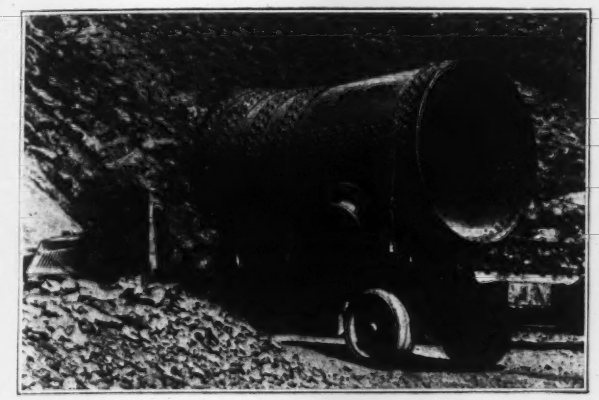
At the outset inspections and overhaulings were made on a mileage basis but this was soon changed to the more effective system of inspecting the parts most subject to trouble at the end of every trip and making a general overhauling whenever the operation of the truck became at all unreliable. An expert mechanician was therefore always on duty at each terminal to inspect every incoming truck and indicate what repairs if any must be made before it could go out. An inspector was also assigned to the road to give aid to drivers where necessary and to ride with and observe the operation of trucks under scrutiny for any reason. Careful study made on the trucks while actually in operation proved to be well worth while. For example, loss of compression, due to excessive wear on cylinder rings, was traced to dust sucked in through the carburetor in the slow trips up the long dusty grades. After clarifiers of a suitable type were put on this trouble was eliminated.

Delaying a truck was considered an out and out loss, hence the organization of freight handling crews was given careful attention. Occasional loss of time on the road was unavoidable but delay at terminals, it was reasoned, could largely be prevented by well organized forces. Loading and unloading crews were operated on a call shift basis. Thus trucks were not held at either terminal except to wait their turn when they arrived faster than they could be loaded or unloaded. All loading and unloading, both on company and private trucks, was done by company forces and the company reserved the right to assign the kind of freight and to limit the quantity per load taken by private trucks.

Constant care was required to keep the several units of the transportation scheme co-ordinated. For example, a number of cars of freight arrived on which waybills had been lost. The railroad would not permit the cars to be opened until the missing waybills were found. Of course, demurrage was not being charged while the cars were locked but the company suffered a demurrage loss nevertheless because when the cars were finally released they were ready without warning. To have moved this additional freight without any hitch in regular procedure would have meant an additional supply of trucks and freight handling crews.

Normally the rate of receiving freight at Caliente was between six and eight cars a day. During sum-

mer weather it was desired to get a stock of cement stored at headquarters camp so as to decrease the necessity of maintaining continuous freight service in winter. Hence that commodity came in at the rate of five cars a day. Besides this, miscellaneous freight was usually received at the rate of three to five cars per day. Because of the long railroad haul and the heavy grades between Caliente and Los Angeles, there was no dependable rate at which freight arrived at the Caliente siding. The variations ranged from 29 cars in two days down to nothing for days at a time when no freight trains came through. Experience with these conditions demonstrated the need for large warehouse capacity at the rail terminus. The storage space had to be increased from time to time, particularly for cement. It was found to be good policy to keep the warehouses half full. This afforded equal



AN 11-TON LOAD EN ROUTE TO KERN PROJECT

protection in both directions, i.e., stoppage on the railroad that would leave the trucks idle or truck shortage that would result in demurrage on cars that could not be unloaded.

With so many trucks on the road the difference in time made on the 50-mile haul made a considerable diversity factor in loading requirements. Despite this, during the height of the season there was occasionally a lineup of a dozen or more trucks waiting to be loaded. At such times the policy of "first in, first loaded" was strictly observed. Truck drivers were not required to wait on their trucks in such lineups. A run over the road one way constituted a shift and on arrival the driver turned the machine over to a "spotter" who took responsibility for seeing that the load was properly checked off and delivered to the right place, that the truck was inspected, got gas and water, and was turned over to the next driver all ready for the return trip.

The type of truck selected by the company for handling the heavier loads consisted of two parts, a four-wheel motor section and a two-wheel trailer section, as shown in the illustration. The trailer could be detached from the motor by jacking up the front end of the former and supporting it temporarily on trestle or strut. This was a timesaver at terminals and increased the flexibility of the fleet.

The handling of unusually heavy loads was studied in detail. Of the freight handled in quantities, the 11-ton pipe sections were some of the largest pieces. These were put only on trucks that could safely carry 15 tons. Even these trucks at times could take these loads over the heavy grades only by "bucking," that is, by halting on the grades to speed up the engine, pulling forward until the engine was about to stall and then repeating. This, being extremely hard on the equipment, was avoided by coupling a 4-ton truck with a 3-ton load ahead of the one carrying the pipe section.

Pieces weighing up to 32½ tons are allowed in the generating equipment specifications and company officials directing the truck operations see no particular difficulty in delivering these by trucks except the question of getting across streams. A trailer carrying this load and three trucks for motive power, each with enough load to give traction, would weigh about 75 tons all told. Of the three trucks, two would pull and one would push, the latter being behind to facilitate backing up, if that became necessary. Of course, such loads could not use the bridges and it is anticipated that special stream crossings that could be provided at low water will have to be used.

Operation of Denver Water Plant Under City Control

All Rehabilitation Funds Must Come from Revenues, as There Are No Other Provisions for Financing—Water Famine Imminent

FINANCIAL results of the first 14-months operation of the water-works of Denver under municipal control are given in a report to the City Council, March 10. The latter body had requested information as to why extensions which it had ordered were not carried out. The reply of the Board of Water Commissioners in substance is that up to Dec. 31, 1919, it had spent or encumbered with contracts and orders for material a sum greater by $219,451.33 than the net income from operations, $475,084.95. The total income was $1,915,-012.87, from which was deducted interest on bonds, $726.316.08; insurance, $8,692.55; refunds on water licenses, $17,484.02; taxes, $26,172.65; operation and maintenance, $661,262.62. Of this latter sum upkeep of the mine conduits cost $106,018.01.

Discussing the financial difficulties the report states that the charter provides that the maintenance, operating expenses and interest shall be paid first. If any revenue remains it is to be applied to capital construction, but no other means of financing extensions and betterments exist. There was deducted from the purchase of the plant $630,000 for depreciation, yet no funds were given the board to rehabilitate the plant as a result of this depreciation. During the period of the option to buy the plant the Denver Union Water Co. was not permitted to make improvements other than those authorized by the Public Utilities Commission. Several essentials which the company desired to make, says the report, were denied. During the option period the company did only such maintenance work as could not be postponed.

Some of the features which the board on taking over the plant found required immediate attention, and for which it had no funds, was as follows: Several areas, notably the stock yards, were inadequately supplied with water for domestic use and practically none for fire protection. The wood stave conduits, some of which had been in service more than 25 years, required extensive repairs. To provide insurance against a water

famine in the event of breakage of one of the old lines, contracts were let for 10,000 ft. of 54-in. reinforced-concrete pipe. Not more than this amount can be built in any one year, and it will require 5 years to complete this line with the funds available. The seriousness of the situation is indicated by the fact that only 78,000,000 gal. daily can be brought into the city, the storage is 75,000,000 gal., while the peak load in 1919 was 86,500,000 gal. If the peak load continues for 6 days the limit is reached without the breaking of any conduits

For present needs the board recommends an immediate increase in conduit capacity to carry a total of 100,000,000 gal. daily and, if consumption and waste is to continue as in the past, additional reservoirs must be built and the distribution system amplified. Ten years hence the city should have conduits with a combined capacity of 150,000,000 gal.; modern filters must be constructed at Kassler and Marston Lake, an aerating basin at Marston Lake must be built to eliminate the odors occasioned by vegetable growth, and many miles of distribution and feeder mains must be laid.

Retaining Wall in Deep Cut Displaced by Slide

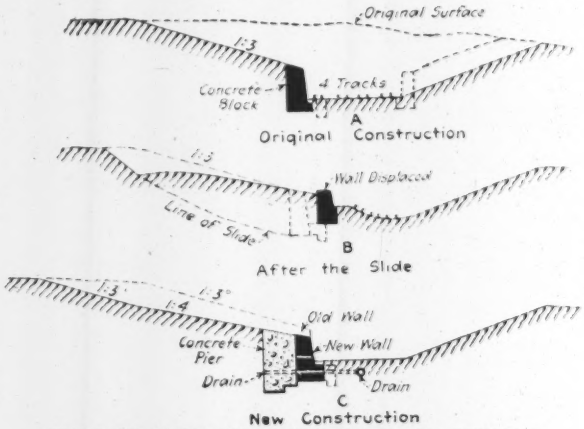
Moving Earth Pushes High Wall Outward 20 Feet Without Overturning It—New Wall Made Lower and Carried Deeper

A LANDSLIDE which blocked the four-track main line of the Great Central Ry., England, illustrates the risk of cutting through unstable material, although conditions may make such construction necessary. At Wembly there is a cut nearly a mile long through soft clay, at a maximum depth of 80 ft. According to an article in the *Revue Generale des Chemins de Fer*, the construction was considered undesirable when the railway was built in 1905, but since the line had to pass under existing railways near each end of the cut it was impracticable to raise the grade and a four-track tunnel was considered too costly.

Concrete retaining walls were built for about 1,600 ft. at the deepest part of the cut, mainly on the high side, as shown in the accompanying drawing. At the maximum section the wall was 30½ ft. high above subgrade and 14½ ft. thick, with the footing 8 ft. below grade in a stiff blue clay that appeared to afford ample stability. To prevent sliding, concrete blocks 10 ft. long, 8 ft. wide and 14 ft. thick were built at intervals along the face of the foundation below subgrade. Behind the wall 6-in. drains were imbedded in broken stone, leading to weepholes at 10-ft. intervals, while a drain along the top of the wall carried off surface water. The face of the cut above the wall was dressed to a slope of 1 on 3.

No cracking or displacement of the wall was noted until February, 1918, but there had been some sliding of the ground above it and a system of dry stone drains was laid along the slope. The first indication of movement of the wall was the raising of the adjacent track, which was at once closed to traffic. Cracks in the slope gave evidence of a serious disturbance of the earth and it was noted that wood struts between the retaining wall and the track ditch were under heavy pressure. Four days later a 600-ft. length of wall was sheared from its base and pushed outward bodily, as shown at B, in the drawing, the movement at the middle being about 20 ft. At the top of the slope the earth sank nearly 15 ft., leaving a steep face. The slip occurred within a few minutes and affected all the tracks, so that traffic was suspended. The volume of the moving mass of earth was estimated at 500,000 tons.

To hold the displaced wall, heavy timbers were placed across the floor of the cut, under the tracks, with



WALL IN 80-FT. CUT DISPLACED AND REBUILT

inclined shores bearing against them. To brace that part of the wall which had not moved, 6 x 5-ft. concrete struts and blocks 20 x 20 x 10 ft. were built against the footing. The cut was then widened on the opposite side to permit of laying a double track around the slip. Traffic was resumed within seven days.

As the first step in reconstruction, conrete piers 60 ft. apart were built in heavily braced pits behind the old wall that remained, these piers being 12 ft. long on the face and of a thickness varying with the height. The new wall is built between two piers at the ends of the break, being connected to them by dovetailed joints reinforced with old rails. Its foundations are carried deeper than those of the old wall and the footings are extended to connect with the lower part of the old wall which remains in place below the subgrade and which thus serves as a brace. The new wall is on the original line but its height is 7 ft. less than the old wall, while the surface of the cut above it is dressed to a slope of 1 on 4 and then 1 on 3, as shown at C, thus reducing the surcharge.

A study of the excavations for the piers indicated that the plane of the slide came close to the base of the old wall and followed approximately the dotted line shown in B. The surface of the fault was smooth and slippery, with a shiny appearance, and it was concluded that a film of water had served to lubricate this surface so that the wet superincumbent mass slid upon it.

Greeks Return to Native Land

During the three months' period from the latter part of June to the latter part of September, 1919, approximately 12,000 Greeks landed in Greece on ships plying directly between New York and Patras or Piraeus. The amount of money taken back to Greece by these returning Greeks is very large, reports A. W. Weddell, consul general at Athens. He reports that since Jan. 1 this year more than 130,000,000 drachmas ($25,090,000 at normal exchange) in postal orders have been remitted to Greece from the United States, in addition to moneys taken back by returning Greeks in the form of drafts bank notes, etc.

Determining Bitumen Content in Bituminous Concrete

Surface Area of Aggregate, Its Specific Gravity and Adsorption, and Consistency of Bituminous Cement Are Factors

By Roy M. Green
Professor of Highway Engineering, Agricultural and Mechanical College of Texas

NO PART of bituminous-concrete pavement construction is as little understood as that pertaining to the correct methods of determining the required proportion of bitumen to be used in any mixture. The printed information on the subject is very misleading, and it is certain that successful results would be impossible in many localities in the United States if the specifications that are given in some of the textbooks on the subject were followed. This is true for all parts of Texas, as has been recently demonstrated through an investigation of the existing bituminous pavements in that State. (Bulletin No. 22, "Bituminous Pavement Investigations in Certain Texas Cities, Part I, Bitulithic," Engineering Experiment Station, A. & M. College of Texas, College Station, Texas.) The usual specification for this type of construction, where a formula is actually given, is as follows:

	Per Cent
Bitumen	7 — 9½
Passing 200 sieve	4 — 7
Passing 10 on 200 sieve	24 — 32
Passing ½ screen on 10 sieve	8 — 12
Passing ½ on ¼ screen	12 — 20
Passing 1 on ½ screen	26 — 35
Passing 1½ on ½ screen	36 — 50

The requirement of from 7 to 9½ per cent of bitumen in a mixture having a maximum size of 1½ in. is certainly excessive, for out of a total of twenty-four representative samples of successful bitulithic pavements taken from the streets of various Texas cities only five had as much as 7 per cent bitumen contained in them. Further, the aggregate contained in these samples was, in every case, less than 1½ in. in maximum size and consequently required more bitumen than would have been necessary had the aggregate been larger. It would seem, therefore, that the usual specification for this type of construction does not fit conditions in Texas and it is doubtful if it fits local conditions in many other parts of the United States.

Since the correct proportion of bitumen to be used is dependent upon several factors that are influenced by local materials it would seem desirable to have some sort of test whereby the correct amount of bitumen may be determined for any case. Before explaining the method to be used in making such a determination it would be well to point out the various factors that must be considered in arriving at the correct proportion to be used.

Surface Areas and Film Thicknesses

It is a recognized fact that in order to produce successful results it is necessary to have the bitumen in the mixture from an unbroken film, around each particle, of sufficient thickness to hold the aggregate firmly in place regardless of the thrusting action of traffic. It is also true, with the same type of construction, that as the surface area of the aggregate increases the amount of bitumen must also increase. Since the surface area of the aggregate has some influence upon the amount of bitumen to be used it is of interest to compare the surface areas of a fine and coarse mixture such as sheet asphalt and bitulithic.

One thousand grams of the aggregate from a standard sheet asphalt mixture has approximately 188,000 sq.cm. (202 sq.ft.) of surface area while that of an equal weight of one inch bitulithic aggregate has only an area of 64,000 sq.cm. (69 sq.ft.) (Calculations were made upon the assumption that the average diameter of the particles between any two sieves was the mean of the sizes of openings of those sieves.) In other words, the sheet asphalt mixture has 2.94 times as much area as the same weight of a one inch bitulithic aggregate. (The grading of the aggregate will be given later.) If the thickness of the liquid film of asphalt cement, necessary to hold the particles in place, is the same in both cases there should be 2.94 times as much asphalt cement used in the sheet asphalt mixture as in the bitulithic. This is not the case, however, as the sheet asphalt aggregate will usually carry about 10.5 per cent of bitumen, by weight, while the bitulithic usually requires about 6 per cent. The sheet asphalt carries 1.75 times as much bitumen as the bitulithic while it has a surface area 2.94 times as large.

Reducing this information to the average thickness of films upon all particles it is seen that, in the case of the sheet asphalt mixture, the average thickness of film is 0.000628 cm. while in the case of the bitulithic it is 0.010 cm. Since the aggregate below the 10-mesh size is the same in both cases then the thickness of film for that part of the mixture should be the same, the difference in average thickness being due to the bitumen on the large aggregate. If this is the case there is a thickness of film over the stone part of the aggregate as great as 0.0483 cm. or about 77 times as great as for the very fine parts of the mixture. It is therefore apparent that the percentage of bitumen necessary in any mixture can not be entirely determined by the extent of surface area.

Effect of Consistency of Bituminous Cement

The thickness of the surface film of bitumen over each particle is influenced by the consistency of the bituminous cement in the mixture. This fact would seem self evident, as it is apparent that the more fluid the material is the thinner the covering over each particle may be made and still have a sufficient thickness to be continuous. The importance of keeping the bituminous cement at the proper consistency for mixing is therefore evident if close control of the product is desired.

If all aggregates were composed of the same minerals the determination of the percentage of bitumen would be greatly simplified because for a given consistency of bituminous cement equal surfaces would require equal amounts of bitumen, when dealing with the same type of mixture. It is natural, however, that an aggregate composed entirely of quartz will retain less bituminous cement than one composed of more or less soft limestone. As an illustration of this difference in carrying capacity, limestone, broken to the size for use in topeka construction, that has commonly been used in many Texas cities, carries approximately 11.1 per cent, by volume, of bitumen, while commercial trap rock broken to the same size carries only 8.2 per cent. This fact, in conjunction with the added fact that their specific gravities are very different, has been respons-

ible for some of the failures of topeka bituminous concrete pavements in that state, in cases where the same plant weights were used for both kinds of aggregate.

Another difficulty which must be considered is that due to the difference in specific gravity of the various large aggregates now in use. The specific gravity has an influence upon the proportion because all mixtures are made at the plant by weight when the real purpose is to obtain the correct volume of bitumen. Returning again to the comparison of the trap rock and limestone, referred to above, the limestone has a specific gravity of 2.65 as compared with 3.18 for the trap rock. If the intention is to use equal volumes of bitumen, say 15 per cent, by volume, it is necessary to have 6.23 per cent, by weight, bitumen for the limestone aggregate as compared with 5.25 per cent, by weight, for the trap rock. It is apparent that it would be disastrous if the same amount of bitumen, by weight, were used in each case even though the aggregates might have the capacity for carrying films of equal thickness upon their surfaces.

Method of Proportioning

From the foregoing discussion, it is seen that the operator of a bituminous mixing plant must consider the surface area of the particles that are to be coated and the capacity of the aggregate for retaining the bituminous cement. In putting this into practice, however, the operator obtains information concerning the surface area by consideration of the grading of the particles and the specific gravity of the aggregate. These considerations would seem to point to the logical method for proportioning the bitumen in an aggregate which is composed of a mixture of stone, sand, and stone dust, which is as follows:

Separate the aggregate on the 10-mesh sieve and first consider the part that passes that sieve. The illustration taken is that for bitulithic with an aggregate of the following grading.

	Per Cent
Passing 200 sieve	4.8
Passing 80 on 200 sieve	9.6
Passing 40 on 80 sieve	12.8
Passing 10 on 40 sieve	7.9
Passing ¼ screen on 10 sieve	13.3
Passing ½ on ¼ screen	17.8
Passing ¾ on ½ screen	17.9
Passing 1 on ¾ screen	17.9

Since the aggregate below the 10-mesh sieve has the same range of size as that used in sheet asphalt construction the percentage of bitumen necessary for that part of the mixture is determined in the same way, namely, by the "Pat Stain." (A complete description of this test is given in "The Modern Asphalt Pavement" by Clifford Richardson, p. 514.) The stain should be the same as that designated as "Strong" by Clifford Richardson in his book "The Modern Asphalt Pavement."

The material retained on the 10-mesh sieve is then treated as follows, in order to get an idea of the correct amount of bitumen necessary to coat it properly. It is first heated to a working temperature and enough asphalt, of the proper consistency, added to coat all particles. The mixture is then spread in a thin layer upon a clean piece of paper and placed in an electric oven maintained at a working temperature, and allowed to remain for 30 min. The excess of asphalt cement will run off the stone and leave it thoroughly coated. The stone is then struck off the paper with a hot spatula and allowed to cool. After cooling it is weighed and the amount of bitumen used is thereby determined. If a natural asphalt has been used, containing mineral matter, or if a check is desired, an analysis of the sample may then be made. In case there is such a great excess of asphalt in the sample that the stone cannot be removed from the paper without taking a large amount of asphalt with it, a second heating may be resorted to, using the same sample with a fresh paper.

Knowing the percentage of fine aggregate and coarse aggregate in the mixture and the percentage of bitumen necessary for each, the percentage of bitumen necessary for the finished mixture may be easily calculated. For example, if the foregoing aggregate requires 11 per cent of bitumen to coat the fine aggregate and 3 per cent for the large aggregate, the finished aggregate would require 5.8 per cent of bitumen. Since in this grading there is 33.1 per cent of the aggregate passing the 10-mesh sieve and 66.9 per cent retained on that sieve, the foregoing result is obtained as follows: $33\frac{1}{10}$ g. of fine aggregate will require 4.09 g. of bitumen, which is 11 per cent of the total of 37.19 g. of fine aggregate and bitumen necessary for that aggregate. Sixty-six and nine-tenths g. of large aggregate will require 2.07 g. of bitumen, which is 3 per cent of the total of 68.97 g. of large aggregate and bitumen carried by that aggregate. This makes a total of 106.16 g., of which 100 g. is aggregate and 6.16 g. is bitumen. The bitumen in this mixture is, therefore, 5.8 per cent of the total sample, this result being obtained by dividing 6.16 by 106.16 and multiplying by 100.

This method of determining the correct proportion of bitumen to be used in bituminous concrete construction takes into consideration all the various factors discussed, namely, surface area of aggregate, consistency of bituminous cement, adsorption of aggregate, and specific gravity of aggregate.

Objection to British Institution as Sole Body To Determine Registration of Engineers

The secretary of the Society of Engineers (British), in a communication to *The Engineer*, states that an executive committee of that body, appointed to deal with the question of the registration of engineers, passed the following resolution Jan. 19:

That this society cordially approves the principle of the registration of engineers, but joins with other objectors in opposing the bill promoted by the Institution of Civil Engineers on the following grounds:

1. Though in the broad sense in which the Institution of Civil Engineers interprets its charter, professional engineers in all branches would be included in the term "civil engineer," it is nevertheless a fact that the term "civil engineer" is employed in a restricted sense, and is so used and understood by the public, by the universities, by technical schools, and by the engineering world in general. As the usage is at present, the title amounts to a misdescription.

2. This society objects to the Institution of Civil Engineers being the sole body to determine who are to be placed on the register. The Institution of Civil Engineers, though a competent authority as regards its own members, has no mandate from the engineering profession as a whole to act on its behalf, and the determining body should be representative. Such a body should consist of members elected by the leading engineering institutions and societies and of certain members nominated by his Majesty, much on the same lines as the general council is appointed to regulate the qualifications of practitioners in medicine and surgery under the Medical Acts.

Dangerous Stresses From Falling Loads on Floors

Multiplication of Static Load Effect Determined by Formulas Based on Assumption of Perfectly Elastic Impact

By J. W. Ledoux
Consulting Engineer, American Pipe and Construction Co., Philadelphia

ENGINEERS sometimes meet concrete mechanical problems concerning which the reference and text-books may be examined in vain for practical aid. A common example is that of a floor on which heavy loads must be moved. The books are very complete concerning the method of proportioning structures for dead loads but extremely vague in regard to loads that are tumbled about.

It is impossible to move machinery and concentrated loads without danger of an occasional fall. Whether moved by hand or otherwise, they are not always laid down quietly; they may be dropped a fraction of an inch or several inches. Take the case of a highway bridge: A worn-out plank may be reinforced by spiking a new plank over the defect, and a heavy truck may drop from the edge of this plank an inch or more to the original floor, or some object may have been carelessly left on the bridge floor, which would produce the same result.

The effect may be illustrated by the idea of a weight dropping on a beam, since practically all floors can be resolved into this simple conception. Consider a weight of W pounds falling h inches on a beam of length L, moment of inertia I, and modulus of elasticity E; it deflects the beam z inches and produces a maximum fiber stress of S pounds per square inch. The pressure of the weight on the beam, which causes the deflection, is greatest when the deflection reaches its maximum, when it amounts to F pounds; the average value of the pressure during the deflection may be called F_1. By an application of the laws of mechanics the following eight relations may be deduced, in which all values are to be expressed in pounds and inches:

$$\text{Deflection, } z = \frac{FL^3}{rEI} \tag{1}$$

$$\text{Pressure, } F = \frac{kSI}{Lc} \tag{2}$$

$$\text{Work done, } W(h + z) = F_1 z \tag{3}$$

$$\text{Av. press., } F_1 = \tfrac{1}{2} F \tag{4}$$

$$\text{Then } F = 2W\left(\frac{h}{z} + 1\right) \tag{5}$$

$$\text{and } F = W + \sqrt{W^2 + \frac{2rWhEI}{L^3}} \tag{6}$$

$$W = \frac{k^2 S^2 IL}{2rhEc^2 + 2SL^2 kc} \tag{7}$$

and the fiber stress is

$$S = \frac{WLc}{kI} + \sqrt{\left(\frac{WLc}{kI}\right)^2 + \frac{2rWhEc^2}{k^2 IL}} \tag{8}$$

The half depth of the beam is denoted by c, while r and k are constants of deflection and bending moment, respectively; r has the value 3 for a cantilever beam loaded at the end, and 48 for a simple beam loaded at the middle, while k is equal to 1 and 4 for these two cases.

The formulas err on the safe side, because no allowance is made for inertia of the beam or for the local effects of impact. It should be noted also that the beam is assumed not to be stressed beyond the elastic limit, so that it remains perfectly elastic.

As a concrete case take a yellow-pine floor plank acting as a simple beam 12 in. wide by 3 in. thick, and 60 in. long, and assume a weight of 500 lb. to drop 1 in. on its center. Formula (6) shows this to be equivalent to a steady load of 3540 lb. Formula (8) shows the maximum fiber stress to be 2950 lb. per square inch, or nearly seven times as great as with a steady load of 500 pounds.

The purpose of this presentation is not to suggest increasing the usual allowances for structural beams to allow for dropping loads, but rather to call attention to the danger of carelessness in permitting them to fall.

Sewage Treatment Plans for the Chicago Sanitary District

WITH the intent of starting construction at an early date on a comprehensive program, studies are now being made of the treatment of the sewage of the entire Sanitary District of Chicago. This announcement accompanies one to the effect that construction will start soon on a plant to treat the sewage of the Calumet region for which a sedimentation plant will probably be installed, so designed as to be convertible into an activated-sludge plant.

An activated-sludge plant at Maywood is now under construction to treat the sewage from towns along the Des Plaines River above Riverside. With the exception of this plant, which will abate the nuisance in the Des Plaines River Valley by October, 1920, the district has devoted its major disposal efforts toward the treatment of industrial wastes from the stockyards district, wastes from tanneries in the North Branch of the Chicago River, and also wastes from the Corn Products Co. at Argo.

Negotiations are practically completed with the stockyards interests for the construction of a large activated-sludge plant which may cost eventually $9,500,000. Construction of the first unit may be started this season. Similar negotiations are in progress with the tanning and other industries, while the district and the Corn Products Co. have agreed to provide funds jointly for an experimental plant to treat its wastes. An experimental plant is also in operation on wastes of a large chrome tannery of the Griess-Pfleger Co.

With the completion of the Calumet-Sag channel and the Calumet intercepting sewer during the coming winter, all sewage now discharged into Lake Michigan in the southern part of the district below 7th St. can be diverted into the main drainage canal. To prevent this sewage from increasing the pollution of the canal and subsequently the Illinois River, the Sanitary District has purchased the 106-acre site of the old Pullman sewage farm at $159,600 on which it will at once begin construction of the works mentioned in the opening paragraph.

Topographical Survey of Flint, Mich.

In the article on the topographical survey of the city of Flint, Mich., in *Engineering News-Record* of April 8, p. 700, it should have been stated that this survey was made under the direction of Ezra Shoecraft, city engineer, who engaged the H. H. Randall Co. to carry out the work

Panama Canal and Arkansas Razor Backs —*A Feat in Mathematical Gymnastics*

By R. L. Kirkpatrick
Balboa Heights, Canal Zone

IT is related that the halls of Congress once resounded from a speech by one of Arkansas' enthusiastic representatives on the then moot subject of changing the name of Arkansas. In his eulogy of the might and resources, supposedly accumulated and due to the existing name, he stated that if all the hogs raised in Arkansas each year were a composite hog it could dig the Panama Canal with one swing of his snout.

It may serve to give a more concise idea of the yardage excavated on the Canal, if an analysis is made of the yardage in terms of rootings by this composite hog, or to supply the necessary number of hogs and give them one root apiece; incidentally illumination may be cast on some of the inaccuracies of occasional over-enthusiasm in Congressional debates.

Up to Jan. 1, 1920, 252,132,590 cu.yd. of excavation had been taken from the canal prism. A really excellent New York newspaper almanac, probably not consulted by the Congressman in question, gives the swine population of Arkansas in 1918 as 1,643,000, valued at $22,180,000.

In good Iowa and Illinois sod the writer has observed plump and vigorous Poland-Chinas overturning, he estimates, at maximum output, a ½-gal. measure of soil per swing per snout. This was in early April when the spring rains had made the green herbs and grubworms underneath especially desirable and succulent, filling the hog with a *consuming* desire for high achievement. On a basis of Panama Canal yardage his work figures out as follows:

One-half gal. equals 231/2 × 1728 × 27 equals 0.00247 cu.yd. per swing per snout, and 252,132,590/0.00247 equals 102,100,000,000 flourishes per hog, or 102.1 billion hogs rooting at one time.

It must be granted that the Arkansas razor back is an unusual excavator, likely he excels his more northern brother as a steam shovel even if he is not such a lard can. On the other hand the razor back has small incentive to put forth his best efforts for forsooth he must work with low morale; near three-quarter of his labor must be in soft or hard rock classification on the canal job. His is to be a hard labor with small reward. Granting that his hog-like persistency may keep him at work anyhow, he has a physically impossible task at his Iowa relative's pace. Let us help him out by supplying one-half more of him, i.e, put 51.05 billion more Arkansas hogs to work or 153,150,000,000 hogs in all and give them a root apiece. It is seen that our *reductio ad absurdum* method casts considerable doubt on the Congressmen's razor back prides fulfilling the specifications.

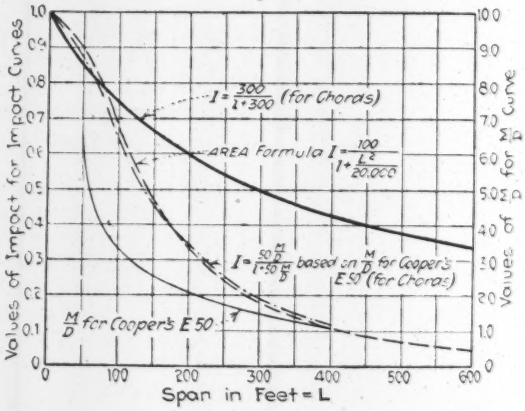
Calculating in terms of a composite hog to do the Canal job in one expenditure of energy it may be assumed that Arkansas' porcine population may displace 3 cu.ft. when he takes his daily wallow in the nearby swamp and that he weighs 150 lb., i.e., he weighs 150/3 or 50 lb. per cu.ft. It follows that our Arkansas hog is very sizable as he weighs 153,150,000,000 × 150/2000 or 11.486 billion tons, and he occupies 11.486 billion × 2000/50 × 27 or 17.10 billion cubic yards.

If pork is worth 15c. a pound, a ton of pork on the hoof is worth $300 per ton and 11,486,000,000 tons are worth $3,445,800,000,000. This composite hog seems to be a valuable piece of property, too much so to use for steam shovel purposes. His value may be sufficient to pay off the world's debts, to buy a few oil stocks, and make a few careful selections in investments in Mars, Saturn and Jupiter. It is wondered how many other of the Congressional effusions per day may not stand the light of mathematical investigation.

An Impact Formula Applicable to Ballasted and Concrete Bridges

By H. M. Gibb
Rawalpindi, India

A NEW impact formula has been devised by the writer to make the impact dependent on the ratio of live load (M) to dead load (D) and also dependent on the loaded length of the bridge. It agrees very closely with the A. R. E. A. formula for values of M/D based on Cooper's E50 loading, and is therefore in conformity



GRAPH OF NEW IMPACT FORMULA AND TWO OTHERS

with current practice for steel bridges. When steel bridges with ballasted floors or reinforced-concrete bridges are considered the A. R. E. A. formula makes no reduction in impact for the greater dead load of these types as compared with open-floor steel spans. The new formula is,

$$I = \frac{50\,M/D}{l + 50\,M/D}$$

I = impact coefficient or the proportion to be added to the live-load stress to allow for impact.
l = loaded length of the span in feet which produces the maximum stress in the member.
M = live load per foot of loaded length l.
D = dead load of whole structure per foot of span (but in computing I for the floor system, D includes only the dead load supported by the beam under consideration plus the weight of this member).

The diagram herewith shows above formula graphed. The ratios of M/D used have been derived from the graph given on page 24 of Part III, "Modern Framed Structures," by Johnson, Bryan and Turneaure, using Curve B for dead load. The live load is Cooper's E50. The A. R. E. A. formula and the new formula proposed in the present article give curves which are very similar throughout and practically the same values of impact. When M/D is 6.0, which occurs when the span is about

50 ft., the writer's formula is identical with C. C. Schneider's formula, $i = 300/(l + 300)$; for greater values of M/D the results are very slightly greater than those of the Schneider formula. It therefore conforms very well to existing practice and is also simple to use.

For a steel span of 16 ft., the new formula gives impact of 98 per cent; for a reinforced-concrete slab of the same span 86 per cent. For a 100-ft. steel span with open floor and for one with a reinforced-concrete floor and ballast the impact values are 64 per cent and 29 per cent respectively.

The formula is also susceptible of the usual variations to allow for structures carrying more than one track and to make the value for zero span other than 1.00

Record of Engineers Suggested by Doctors' System

American Medical Association's Method of Keeping in Touch With History and Practice of 160,000 Physicians

By Everett Judson
Sanitary Engineer, With the Hill Pump Valve Company, Chicago

THE relation of engineers, individually and collectively, to society is the leading theme of engineering discussion. Raising the standard of professional ethics, reorganizing of engineers into a more influential association, and the securing of just remuneration for service rendered, are among the leading topics. In recent Government work the writer, as assistant sanitary engineer of the United States Public Health Service, became acquainted with certain activities and services of the American Medical Association which are worthy of careful consideration by those interested in the engineer's problems.

The American Medical Association has approximately 80,000 members, including only physicians who are licensed to practice in one of the states or territories of the United States. Each member is, first of all, a member of a component county society. The county medical societies are joined into state associations, and these state associations unite to form the American Medical Association. Keeping in touch with its own membership would seem a sufficient task for the association, considering how completely it is done, but in addition the association maintains contact with about 80,000 medical men who are nonmembers. This keeping in touch with 160,000 men does not mean just knowing where they are, but also what is their education, what they have done and what they are doing.

This task is assigned to the biographic department. Here we find recorded for each physician the year and place of his birth, high school and college or colleges attended, name of medical school and year of graduation, state wherein licensed, date of license, and latest address. Also the record of his interneship. Through the catalogs of the various medical colleges and schools the entrance requirements and the courses given are obtained. To aid in judging the value of the training, information about the faculties is necessary, so records are kept which show the character and amount of experience of each professor and instructor.

After completion of interneship the building up of practice begins. Through the secretaries of the various state medical licensing boards the biographic department obtains lists of all new physicians licensed in each state. The secretary of the county medical society or one of the correspondents advises the biographic department when the new man locates himself. By the same means the department learns of men who excel in some special line of endeavor. Others may have distinguished themselves in research work, and their writings are published. Still other may be holding some public office for which their training has especially fitted them. On the other hand, a man may be accused or found guilty of questionable or illegal practice. All this information is pretty sure to reach the biographic department. In a few cases it was discovered that doctors were running "diploma mills." The association promptly published the facts, and this publicity enabled public sentiment to put the "mill" out of business.

The biographic department originated from the necessity for the American Medical Association to know all that it was possible to know about each member of the profession, so that it could judge more intelligently the value of papers sent for publication in the *Journal*. Then, too, it keeps the data up to date for the American Medical Directory, which it publishes every two years.

This much the biographic department does for the American Medical Association, but let us consider now what it does for the public. When the Army and Navy were confronted with the task of building up a large personnel in a very short time, they were able to accomplish it without sacrificing quality. The officials were not acquainted with the thousands of men who offered their services, and to have verified the data through correpondence would have taken a long time. But through the coöperation of the American Medical Association the files of the biographic department were placed at the disposal of the United States Government, and the Government's data were quickly supplemented and verified.

During the influenza epidemic of 1918 the United States Public Health Service appointed several hundred medical men for emergency work. These were obtained in the shortest possible time, and still the public received the best medical aid available, owing to the coöperation of the association. Other Government bureaus make use of this service, and it is the policy of the American Medical Association to extend the services of its biographic department to representatives of the Government when this will serve the public interests.

It is realized that the engineering profession has no centralized organization like the association, and that the two profesions are decidedly different in several respects. Probably a complete record of the individual who offers an article for publication in an engineering magazine is not so essential as is the case with the *Journal* of the association. However, the opinion is held that in the present reorganization of engineers provision should be made for establishing a department similar to that described above. The present leaders are working for more centralization, and as this problem is worked out provision could be made for collecting data regarding engineers, while the data already in the files of some of the organizations could be taken over by such a department.

The expense and effort of organizing the department would be justified in many ways. It would hold a restraining hand on those few who might otherwise attempt questionable practices. It would improve the standard of professional ethics. The service which it could render the Government in a crisis is apparent. Its

usefulness in peace times, though not spectacular, would be far-reaching. The industrial and educational value of a directory of engineers modeled after the "American Medical Directory" can be readily appreciated, for it would contain information concerning the college or colleges which a man attended, together with the date of graduation and the degree conferred, his connections with the recognized engineering and scientific societies, and a brief statement of his experience. The benefits of such a department to the public and the profession will be manifold if its establishment is undertaken and carried through in the spirit of justice and service to all.

Rising Cost Effects as Viewed in Iowa

A DISCUSSION of the varied and in some cases disastrous effects of rising costs on municipal work in Iowa was precipitated at the recent meeting of the Iowa Engineering Society. B. J. Whipple, of the Lehigh Sewer Pipe & Tile Co., stated that in tile manufacture increases in freight had been 25 per cent for long hauls and 18 per cent for short hauls; 123 per cent in coal and 127 per cent in labor; other items in proportion.

C. T. Wilson said that the time was rapidly approaching when the 25 per cent limit of assessed valuation would be reached and municipal improvements would have to cease. Some of the difficulties encountered by the contractors he enumerated as follows: On work carried over from last season the material men would not carry over last year's quotations; recent legislation secured by the bonding companies required bonding for the full amount, thus eliminating smaller and weaker contractors; labor cost twice as much and was only half as efficient as in pre-war days; materials had doubled in cost and were still rising; delays in payment when the job had been completed tied up unnecessarily the contractors' funds.

"Old data on unit costs must now be translated from money to man-hours with an estimated efficiency factor," said M. G. Hall. He was of the opinion that some contractors were more careless than formerly, allowing work to proceed inefficiently and thereby running up the cost. J. G. Thorne, a contractor, was of the opinion that the engineer and contractor did not get close enough together on the various units used in estimating. He stated that assessed property values would have to be raised or work would stop. Another contractor stated that the contractor on outside work must not bid more for labor than industry; otherwise industry would soon call for construction curtailment. [This has actually happened in a case in Michigan.—EDITOR.]

J. H. Dunlap indicated that it was the proper function of the society to help adjust conditions. Members now were writing to the secretary asking for data on unit costs. Their collection would be a proper work for a permanent secretary. Seth Dean stated that the best source for cost figures he had found was the business news sections of the technical journals and he made a plea for engineers to be more careful in giving unit costs to the journals.

Mention was made by W. W. DeBerard of a proposed Eastern contract whereby some of the extra-hazardous conditions would be assumed by the owner. A schedule of wages and freight rates and material would be set up. If prices went higher the owner paid 75 or 80 per cent of the advance but if lower the contractor would benefit.

Is the Workman Responsible for High Labor Cost?

BY DAN PATCH
Aberthaw Construction Co., Boston, Mass.

THERE is much talk abroad as to the decreased output of that part of the industrial population known as "productive labor." The writer has had cited to him several instances to the effect that workmen are not doing their customary tasks in the construction game. The concern for which the writer works, as a member of the "non-productive" and less criticised, but no less guilty part of the force, has an interesting system of following the cost of work under construction, which by the way is all contracted for on the basis of cost plus fee.

To the superintendent of each job is issued what is known as the job "bogey score." This is a tabulation of the various operations to be performed, quoted in quantity of each and cost per unit at which it is believed each should be performed with labor at the wages prevailing.

For some years the costs made on the various job operations have been corrected back to a standard wage and either flat units or curves of units established as standards from which to set the "bogey" units for new construction. A study of these standards and the plotting of the costs of jobs completed in 1919, raised the question as to whether these later costs indicated the much talked of reduction in production.

Accordingly some of these data have been re-plotted in such a way as to bring out the answer to this question. It is to be noted that, because our concern was, like many others during the war, engaged in construction not of the typical reinforced concrete design, few data are available for 1918. These data, together with personal observations on the jobs now under construction, have led the writer to believe that slacking on the part of the individual workmen is not the cause of a large increase in the labor cost of building construction. If this is so, what *are* some of the factors which have increased the labor costs of construction work beyond the point which the advance in wage rates would seem to justify.

FACTORS MAKING HIGH LABOR COSTS

First: An increase in the amount of overhead cost. This is caused by the following items.

(1) Additions are made to the overhead field organization due to transportation and labor conditions. Men are hired to trace and get through cars of material which under normal conditions would come through without such chasing. This is properly a material charge, like freight, but of necessity gets into the job pay roll and increases the labor cost. Due to shortage of labor, scouts are used to locate the necessary help. Due to difficulties of transient labor in finding lodgings there is an additional pay roll in order either to erect bunk houses or scout for housing.

(2) In most field offices and in many drafting and engineering offices the old practice of paying weekly wages for an indefinite or long number of hours, has given way to paying a weekly rate based on 48 hr. with rate and a half pay for all time beyond the 48 hr. This has increased the overhead cost.

(3) Jobs which formerly ran on a 10-hr. day are now running on a 9-hr. day and some on an 8-hr. day. This

increases the ratio of overhead to productive labor, as well as the influence of start and stop time. This overhead factor will be reduced somewhat when normal transportation conditions return and when labor supply can properly meet the demand.

Second: Comparisons of labor costs are usually made on the basis of the nominal wage rate of the trades. Prior to the war, or at least some years ago, the overtime rate was in many instances the same as the regular hourly rate and comparison on the basis of wage rate was approximately correct. The following quotation from a report on brick mill construction, dated Sept. 14, 1914, is significant. "There is no necessity of paying men extra time after 8 hr. have expired nor upon Saturday afternoon, as men are perfectly willing to work at the usual rate of wages in order to complete any certain job that they are on, provided their foreman has maintained an enthusiastic and loyal spirit in his gang at all times."

Such is not the fact today and most mechanics are working on a basic 44- or 48-hr. week with rate and a half for all time in excess. This may make the rate from 8 per cent to 15 per cent greater than the nominal rate. The following figures indicate why overtime has been resorted to for the trades while unskilled and unorganized labor has had less of such overtime and has been willing to work a longer basic week. According to the data of the U. S. Dept. of Labor the index number for wholesale commodity prices has increased from 132 in 1914 to 206 in 1919, an increase of 56 per cent. Wage rates for the same period have increased as follows:

	1914	1919	Per Cent
Masons	$0.65	$0.90 to 1.00	38.5 to 24
Carpenters	0.55	0.80 to .85	45.5 to 54.5
Laborers	0.25	0.50 to .55	100 to 120

Organization evidently acts as a damper to the law of supply and demand. The man with a trade must have enough overtime to bring his real rate up to the per cent advance in commodities or there will be injustice done him. This overtime to mechanics is similar to the bonuses paid by some commercial and banking houses to their employees. It allows a little chance to reduce expenditures when the period of prosperity breaks, without reducing wage or salary rates. Unorganized, unskilled labor may follow the laws of supply and demand, though it is possible that, being nearer the critical line, and being where the largest rent increases have occurred, buying in small quantities, working more intermittently and moving often, the laborer has needed more than proportional increases to keep abreast.

This factor will be reduced when the present boom of industrial expansion to get world trade while prices are high is over, and Europe is back on the job as a competitor with fair exchange values.

Material Storage Necessary

Third: On account of congested production and transportation of materials entering into building construction, deliveries are called for considerably in advance for the time when the material can be built into the structure, in order to be sure of having it at hand when needed. On a certain percentage of this material the anticipated delays will not occur, and material will have to be unloaded and stored away from the proper place, to be re-handled later and to be teamed, adding to the labor cost of the building. This factor will be reduced with the return of normal production and transportation of building materials.

Fourth: Due to the demand for speed in construction, jobs are started before the engineers have completed the design and working plans. This precludes a comprehensive planning, and adds to the labor cost.

Fifth: The trades are becoming diluted. Employers have hired and unions have admitted to their membership many men who are rated as journeymen, but who have hardly had the training or experience formerly required before a workman could be thus rated. This means that without any moral obliquity or intentional slacking a given number of men cannot, due to lack of "know how," do as much today as a few years ago. Unfortunately this condition has been intensified in many cases by a lack of foremen to supervise the gang properly. This factor may be reduced by the employers and unions getting together on the question of apprenticeship, training and journeymen standards. A boom in construction is accompanied by a rise in unit costs, a small building program by a drop in unit costs.

It is one thing to charge labor with being inefficient, which may be largely a force of circumstances or up to the management, and quite another thing to charge labor with being unwilling and lax in performing its duty.

California Water-Power Needs Increasing

NORMAL industrial and commercial growth of California, and the power demand incidental thereto, will require the increase of electrical generating facilities at the rate of 60,000 kw. per annum, according to the estimates recently made by the Railroad Commission of that state. To meet these needs the requisite expenditure is estimated to be about $20,000,000 annually.

There are now under way four large hydro-electric projects in California, the completion of which will require a total expenditure of about $25,000,000, according to the Railroad Commission report. These projects (which do not include the Hetch Hetchy development) are expected to be completed within a year and will increase the energy available in the state by about 120,000 kw. They are the Caribou plant of the Great Western Power Co. on the Feather River, the Kerckhoff plant of the San Joaquin Light and Power Corporation on the San Joaquin River, the Kern River Plant No. 3 of the Southern California Edison Co. and San Francisquito Plant No. 2 on the Los Angeles aqueduct.

In addition to these it should be noted that the Pacific Gas and Electric Co. has recently raised the height of its Lake Spaulding dam, purchased and added to its system the power production facilities of the Northern California Power Co., has under way plans to lease the properties of the Sierra and San Francisco Power Co. and is considering a power development on the Pitt River in northern California.

There are 75 hydro-electric plants in the state and 50 steam plants, the combined installed capacity of which totals 770,000 kw. During 1918, 75 per cent of the total number of kilowatt-hours produced was developed in water-power plants. Due to the absence of construction in the past few years, the production of energy from all sources is now far below the amount required to meet present demands.

Fee Schedule for Consulting Engineers

As a guide for fees to be asked by consulting engineers in the Kansas City district the following schedule has been proposed. It was drawn up by W. L. Benham following conferences with several other engineers.

FEES FOR MUNICIPAL AND VALUATION WORK

Size of project	$50,000 to $100,000	$101,000 to $500,000	$501,000 to $1,000,000	$1,000,000 and Upward
Preliminary Investigations, report and estimate	1.50%	1.00%	0.75%	0.50%
Plans, specifications, estimates attending lettings and final inspections and tests	3.50%	3.00%	2.75%	2.50%
*Supervision of construction	2.50% or $250 to $300 per mo. for each man furnished and an extra fee of $25 per day plus expenses when called from office for inspection	2.00% or same monthly charge per man and an extra fee of $35 per day plus expense when called from office for inspection	1.50% or same monthly charge per man and an extra fee of $50 per day plus expense when called from office for inspection.	No fixed sum or per centage but same monthly and daily charge as for preceding class of work.
*Appraisals, including testimony or investigations	3.00% or $75 per day and expense up to $300 and $50 per day thereafter. Minimum fee $1000. Each man furnished at cost plus 50%.	2.00% or same as in previous column.	2.00% or $100 per day plus expense up to $5000 and $75 per day thereafter Minimum fee $2500. Each man furnished at cost plus 30%.	2.00% Same as in previous column.
Reports, investigations, examinations, expert testimony, checking fellow engineers' work, etc.	$75 per day plus expenses up to a fee of $2000, then $50 per day thereafter. Minimum fee, $500. Each man furnished at cost plus 35%.			

*Provision should be made in contracts requiring contractor to pay engineer or city a stipulated fee per month for delay in completing work according to contract

Although it has no official standing and has not been adopted formally or informally, it is based on bookkeeping costs wherein are represented proper profits, overheads, costs of getting business and all legitimate general expenses.

Shipbuilding Profits in Great Britain

According to a statement of the "Times Engineering Supplement" of March, 1920, shipbuilding in Great Britain has made a very good financial record. Ships built in the United Kingdom, it is stated, were turned out at a lower cost than those of other countries, and sold at higher prices.

Of the 821 vessels ordered by the Ministry, 129 were cancelled after the Armistice was signed, 155 were transferred to private owners under the agreement with Lord Inchcape, 120 were transferred on similar terms to their builders, 104 were sold to foreign owners, 156 were sold to British owners direct; while of vessels built abroad 101 were sold to foreign owners and 18 to British owners, while of the total 20 were sunk and 18 are yet unsold. The 260 vessels built in the United Kingdom were sold for £47,900,000—a profit of £11,600,000, as compared with their cost of £36,300,000; but the 119 vessels built abroad cost £26,400,000 and realized only £17,200,000—a loss of £9,200,000—leaving a net profit on the whole programme of £2,400,000. Put another way, it may be said that the United Kingdom vessels cost an average of £139,615 each and sold for an average of £184,231—a profit of $44,616 per vessel; while the vessels built abroad cost £221,848 each and sold for £144,538—a loss of £87,310 per vessel. This seems to prove pretty conclusively that the shipyards of the United Kingdom are as capable as ever they were of competing economically with those of the United States and Canada.

LETTERS TO THE EDITOR

Engineering—A Job or Profession?

Sir—The State of Tennessee, along with other states of the Union, is planning large things in highway work. Large bond issues have been voted and extensive road projects are being, or have been, laid out. To make this possible, the legislature of 1919 passed a General Enabling Act (Senate Bill No. 149) authorizing counties of the state to issue bonds for road building purposes and prescribing rules and regulations for such bond issues and for the conduct of this work. To Sec. 11 of this act, referring to the employment of engineers, attention is called. This section reads as follows:

"Be it further enacted, That said commissioners shall employ a competent engineer, and, if need be, assistant engineers. Said engineers shall be employed to lay out the work on the roads herein provided for or that may herein or by the court hereafter be provided for, making estimates on said roads and work done by contractors building said roads; *and said engineers shall execute to the County so employing him a bond for not less than ten thousand dollars, or more if more should be demanded by the county court of said county employing him, that he will honestly and faithfully execute all work intrusted to his care by said commissioners of said county.* In the event he should wilfully or intentionally fail to execute any work intrusted to his care in such manner as not to be to the best interest of the county so employing him, then said bond shall be forfeited to said county, said bond to be signed by good and solvent personal bondsmen, or by some good bond company authorized to do business in the State of Tennessee; and as a compensation for the performance of his faithful duty, he shall receive an amount as may be agreed upon by him and the road commissioners having charge of said work. *And all engineers so employed by any county in the State of Tennessee under this act shall take and subscribe to an oath before entering upon his duties for said county that he will honestly and faithfully execute all work intrusted to his care without favor or partiality to any section of said county over that of any other portion of said county. Any engineer employed under this act for any county in the State of Tennessee shall be subject to removal or discharge by said commissioners for said county at any time when in the judgment of a majority of said commissioners it appears that it will be to the best interest of said county to make such removal, first giving thirty days' notice of same.*"

The italics in the above act are used to call attention to those particular parts. It is not our purpose to make hostile criticism or to provote such, but we believe that laws should be so framed as to promote rather than to obstruct the progress of the communities they are intended to benefit. Therefore, to that end, their provisions should be such as to offer every legitimate inducement to men of skill and ability to undertake the work contemplated. We submit that the italic portions of the foregoing section of Tennessee's road law will tend to have just the opposite effect. We have not seen the road statutes of other states but we are led to wonder if such provisions in regard to engineers appear in them all. If so, it but emphasizes the pressing need that the engineer should make himself known, that the true character of his services should be understood by the public and that he should establish himself legally upon a professional status by the enactment of suitable license laws in all the states. Until that is done, the engineer will continue to be regarded in the eyes of the law as a hireling and his services will never receive recognition in their true professional character. A failure to command such recognition not only limits the sphere of the engineer's usefulness but indirectly it operates to the detriment of the interest of the public, as is evidenced by the enactment of such laws as the foregoing.

Incidentally the present writer submitted this statute to a leading lawyer of Tennessee and asked him why it was necessary to throw such restrictions around an engineer, why he should be made to give bond (since he handles no money), why he should be subject to discharge at the whim

of a board without its assigning any reason save personal interests, and why he should, in addition, take an oath to discharge his duties faithfully and honestly. We asked this lawyer why the engineer could not be treated as a professional man, like a lawyer or a doctor, and not as a hireling, and evidently regarded as a rascal at that. The lawyer replied that the engineer had no legal status as a professional worker in Tennessee, that he was classed as a tradesman and that such a statute in the present condition of affairs was the only recourse the state had for protection against fraud and dishonesty. In the case of the lawyer or doctor, a revocation of license would punish and remove possibility of practice by the unworthy, but in the case of the engineer anyone could practice who might choose to do so, with no restrictions whatever placed upon him save such as might be put in each particular contract. He very frankly admitted that it is unfortunate that such should be the case, but said until the engineers establish themselves upon a professional basis in the eyes of the law they may expect to be dealt with in just this manner.

We respectfully submit this law to the engineers of the country and ask that consideration be given to it as well as to laws of similar character that may be in force in other states. While we believe engineers should neither expect nor seek class legislation favoring them they should nevertheless do all in their power to secure the amendment or repeal of such laws as the foregoing, that their profession may be recognized and understood in its true nature and that their opportunities for real service may thereby be enlarged and broadened. We believe that in so doing they will not only render a lasting service to their own profession, but will also confer a much larger benefit upon the public as well.

WALTER H. DRANE,
Chief Engineer, Smith Co. Highway Commission.
Carthage, Tenn.

Incompetence and New York's Port

Sir—The editorial on "Incompetence and New York's Port," in your issue of April 8, p. 697, again calls attention to the immense amount of fruitless effort which has been expended in trying to bring the freight-handling facilities of the port up to modern standards. One of the reasons for this failure is the diversity of interests involved, each one powerful enough to defeat the plans of the other. While many people know that New York is the greatest financial center in this country, few realize that it is the largest manufacturing center also. According to the U. S. census bulletin of 1905, more than 55 per cent of the population of the city were engaged in the manufacturing business, and the value of the production was equal to 10 per cent of all the manufactured products in the U. S., greater than the value of the entire foreign commerce.

In order to supply the raw materials, and to take away the finished products, enormous transportation facilities are required and particularly on Manhattan Island which is the heart of this great industrial center. The most intensive development is required where the largest amount of goods are to be handled, and that is on the North River waterfront of Manhattan. Pier rentals in this section run well above $100,000 per annum, with a large number of applications from steamship companies, who can't get dock space at any price, on file in the dock department.

It would seem, therefore, that from the standpoint of the City and State of New York, that the first consideration would be the full development of the freight-handling facilities of the North River waterfront of Manhattan Island. Studies to this end, and reports have been made for the past fifty years or more, beginning with O. Vandenberg, in 1866, who suggested a marginal elevated railroad and since followed by at least fifty others, the majority of whom favored an elevated road, but up to date absolutely nothing has been accomplished, although it did seem as though there was a chance when in July, 1910, the writer with two others, E. P. Goodrich and Harry Nichols, were appointed as a board of consulting engineers to devise a plan for the removal of tracks of the New York Central & Hudson River R.R., from the surface of Ninth Avenue, and also to report on a plan for the improvement of the freight-handling facilities of the North River waterfront.

Unfortunately, this board failed to agree in its recommendation and their work, like their predecessor's, amounted to nothing. There were, however, two points on which the board were in absolute agreement and these were: First, that the freight should be handled through joint terminals located at various points along the east side of West St., and that the railroad occupancy of piers should be reduced.

From pier 1 to pier 42, North River, a distance of 9,765 ft., the railroad's occupy 4,930 ft., or 55.4 per cent.; ferries, 1,087 ft., or 11.2 per cent; leaving only 3,748 ft., or 38.4 per cent for shipping and public piers.

It is the opinion of the writer that any port improvement plan which ignores West St. must be a failure, for what is the use of landing freight in Jamaica Bay or Staten Island which is destined for Manhattan?

If an elevated railroad is built along West St. for the use of all roads, connecting with unit terminal stations on one side and the piers on the other, with a tunnel connection under the river for the Jersey roads, the Jersey waterfront as well as Manhattan can be relieved and the freight-handling capacity increased many fold, and the port problem will never be successfully met until this is done.

ERNEST C. MOORE,
New York City. Consulting Engineer.

Engineering Compensation and Prospects of Federal Government Employes

Sir—I desire to call your attention to an article on p. 754 of your issue of April 15, wherein you state that the Joint Reclassification Committee of Congress has recommended a substantial increase for all the federal scientific and technical services. Attached herewith you will find a table that I have prepared which will show a very substantial decrease for a certain group, and but a miserly increase for another group.

Most of these schedules I have copied from the report of Engineering Council which appeared in the *News-Record*, Jan. 15. Schedule on line two was recommended by the Advisory Committee (see p. 561, March 18, 1920). A further study of table 1 of Engineering Council's report will reveal that, since July 1, 1915, the total increase in salary for the junior grade was 13.3 per cent which, with the 9 per cent proposed by the Reclassification Committee, will make a total of 22.3 per cent.

	Junior Grade			Assistant Grade			Associate Grade			Professional Grade			Senior Grade		
	Max	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
1	2,580	1,620	1,981	4,140	2,700	3,225	5,760	4,320	4,700	7,8[illegible]0	5,940	6,500	....	8,000	....
2	2,580	1,8[illegible]0	2,100	4,080	2,880	3,280	5,460	4,260	4,660	7,920	5,820	6,500	12,000	8,400	9,600
3	3,240	2,2[illegible]0	2,720	3,2 0	3,040	3,400	5,280	3,980	4,600	6,780	5,610	6,040	9,750	8,600	9,175
4	2,1[illegible]0	1,800	1,875	3,000	2,400	2,590	3,840	3,240	3,360	5,040	4,140	4,330	*	*	*
5	3,000	1,000	1,719	4,500	1,020	2,222	5,000	1,800	3,104	7,500	1,800	3,801	10,000	4,500	5,867
6	3,756	1,878	2,818	4,883	2,304	3,600	5,634	2,304	4,312	9,000	5,200	6,381	9,900	9,000	9,450
7	.....	....	+ 9.0	....	....	+16 5	....	....	+ 8.0	....	....	+14.0	....	....	....
8	....	....	—33.5	....	....	—28.0	....	....	—22.0	....	....	—32.0	....	....	....

Line 1—Proposed salary schedule recommended by Engineering Council.
Line 2—Proposed salary schedule recommended by Advisory Committee (see News-Record, p. 561, March 18, 1920).
Line 3—Proposed salary schedule recommended by Bureau Chiefs (see report of Engineering Council).
Line 4—Proposed salary schedule recommended by Reclassification Committee.
Line 5—Salary paid to employees of 16 Engineering Bureaus in Civil Establishments (see report of Engineering Council).
Line 6—Salary paid to employees of 4 Engineering Bureaus in Navy Department (see report of Engineering Council).
Line 7—Average per cent of increase for employees of 16 Engineering Bureaus in Civil Establishments (if proposed schedule of Reclassification Committee is adopted).
Line 8—Average per cent of decrease for employees of 4 Engineering Bureaus in Navy Department (if proposed schedule of Reclassification Committee is adopted).
*Salary not recommended by Reclassification Committee.

Assistant Grade	9.0 + 16.5 =	25.5 per cent
Associate Grade	9.9 + 8.0 =	17.90 per cent
Prof. Grade	5.0 + 14.0 =	19.00 per cent

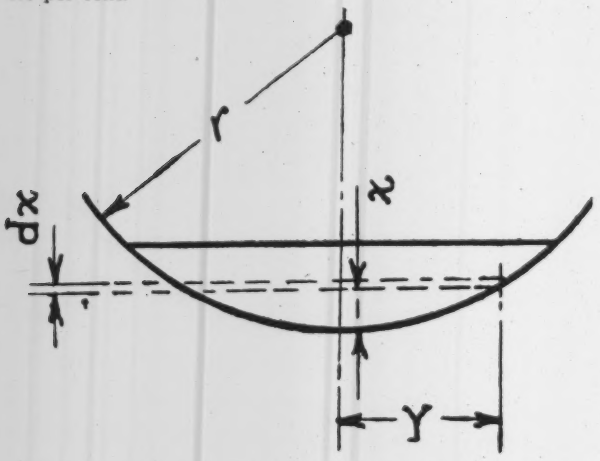
Compare these figures with the increases of 50 to 105 per cent secured by unskilled and skilled labor, and I am sure you will agree with me that the proposed salary schedule of the Joint Committee, if adopted by Congress, will hardly persuade anyone to stay in the Federal Government employ.

A. MIEDWIG,
Construction Division of the Army.

Washington, D. C.

Areas of Segments of Circles

Sir—I have read with interest the many articles appearing in *Engineering News-Record* on the subject of areas of segments of circles, within the last few years. My experience has caused me to be especially interested in this particular phase of calculation. The most promising of these methods and the one most fundamentally correct in its basis was that published in a letter of Leopold Pistner in your number of Nov. 8, 1917, p. 894. This dealt with a calculus method but unfortunately only three terms were given with a corresponding limit of error of 0.03 per cent to 0.6 per cent.



It being my opinion that some of your readers might be interested in a closer limit of accuracy, I have developed Mr. Pistner's theorem to a greater number of terms, and present it here with a different method of development.

Let A = area of the segment.
x = the versed sine, or width of segment.
y = the sine or half the chord.
r = the radius.

By geometry, $y = \sqrt{x(2r-x)}$.

If $r = 1$, $y = \sqrt{2x-x^2}$.

It is evident that

$$dA = dx\,\sqrt{2x-x^2}.$$

First expand $\sqrt{2x-x^2}$ which can be done by Tayler's theorem, the binomial theorem, or ordinary square root.

Tayler's theorem is:

$$f(x-y) = f(x) + f'(x)\frac{-y}{1} + f''(x)\frac{-y^2}{1.2}, \text{ etc.}$$

Substituting $2x$ for x, and x^2 for y we have,

$$\sqrt{2x-x^2} = \sqrt{2x} - \frac{x^2}{2\sqrt{2x}} - \frac{x^4}{8(2x)^{\frac{3}{2}}} - \frac{3x^6}{48(2x)^{\frac{5}{2}}} - \frac{15x^8}{24\cdot16(2x)^{\frac{7}{2}}}$$

$$= \sqrt{2}\,x^{\frac{1}{2}} - \frac{x^{1.5}}{2\sqrt{2}} - \frac{x^{2.5}}{16\sqrt{2}} - \frac{3x^{3.5}}{192\sqrt{2}} - \frac{15x^{4.5}}{24\cdot16\cdot8\sqrt{2}}$$

Integrating this series (see page 319, "Bowser's Calculus") we have:

$$\frac{A}{2} = \frac{\sqrt{2}\,x^{1.5}}{1.5} - \frac{x^{2.5}}{5\sqrt{2}} - \frac{x^{3.5}}{56\sqrt{2}} - \frac{x^{4.5}}{288\sqrt{2}} - \frac{x^{5.5}}{1126.4\sqrt{2}}$$

$$A = r^2\left[\frac{4\sqrt{2}}{3}\left(\frac{x}{r}\right)^{1.5} - \frac{\sqrt{2}}{5}\left(\frac{x}{r}\right)^{2.5} - \frac{\sqrt{2}}{56}\left(\frac{x}{r}\right)^{3.5} - \frac{\sqrt{2}}{288}\left(\frac{x}{r}\right)^{4.5} - \frac{\sqrt{2}}{1126.4}\left(\frac{x}{r}\right)^{5.5} - \frac{\sqrt{2}}{u}\left(\frac{x}{r}\right)^{n+.5}\right].$$

In the above n = number of term.
For any term,

$$u = \frac{(n+0.5)\lfloor n-1\,(2^n-1)}{2\lfloor 2n-5}$$

Where $\lfloor z = 1\cdot3\cdot5\cdot z$

The above formula should be appreciated as an especially accurate and easy one. When it is considered that each succeeding term can be obtained by simply multiplying the preceding one by x over r, and its constant, it is seen to be exceedingly easy of application.

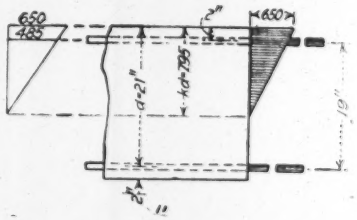
D. W. STARKEY.

Chicago.

Simple Designing of Double Reinforced Concrete Beams

Sir—For many of the cases in the design of reinforced concrete, the use of diagrams based on general algebraic derivations such as those given by Arthur G. Hayden in *Engineering News-Record*, March 25, 1920, p. 634, gives the simplest method of solution. In a few cases, however, the use of the numerical values from the start in the analytical solution is not only simpler but makes possible the design when diagrams or tables are not readily available. This can best be illustrated by an example of rather common occurrence.

Continuous beams of T section nearly always require compressive steel to make up for the deficiency of concrete at the supports where the moment is negative, the dimensions of the beam at such points being fixed by the stem of the T. The problem here is as follows: Given the dimensions of the concrete section of a beam to find the steel required in the top and in the bottom to carry a given moment.



Let us say that the given amount is 900,000 in. lb. and the concrete section is limited to 13 in. in breadth and 21 in. depth to steel, 23 in. total depth. $f_c = 650$ $f_s = 16{,}000$ $n = 15$. The resisting moment of the beam can be considered as the sum of two moments the first being that of the beam without compressive reinforcement and with 0.77% tension steel and the second that of the compression steel and additional tension steel.

The value of the first resisting couple $= R\,b\,d^2 = 107.4 \times 13 \times 21 = 616{,}000$ in. lbs.

The steel required for this couple $= 0.0077 \times 13 \times 21 = 2.10$ sq.in.

The moment to be carried by the second couple $= 900{,}000 - 616{,}000 = 284{,}000$ in. lbs.

If two inches of cover is used at both top and bottom, the arm of this steel couple is $d - d' = 21 - 2 = 19$ in.

When $f_c = 650$ and $f_s = 16{,}000$, $k = 0.378$ and $kd = 7.95$ in.

From a diagram drawn to any scale or by proportion the stress in the concrete 2 in. from the surface of the concrete is 485 and the stress in the steel at this point is 15 times 485, but since the steel displaces an equal amount of concrete it is only 14 times as effective as the concrete.

The area of compressive steel then is

$$\frac{284{,}000}{485 \times 14 \times 19} = 2.20 \text{ sq.in.}$$

and the additional steel for tension is

$$\frac{284{,}000}{16{,}000 \times 19} = 0.93 \text{ sq.in.}$$

which must be added to the steel in the first couple to obtain the total tension steel required or $2.10 + .93 = 3.03$ sq.in.

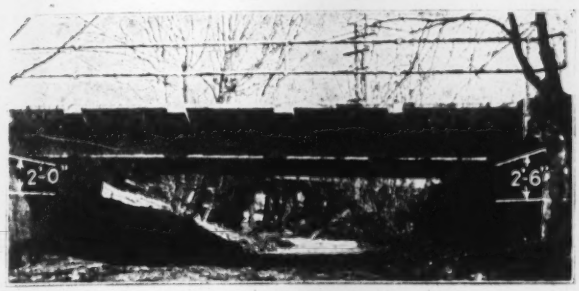
R. R. MARTEL.

Pasadena, Cal. California Institute of Technology.

HINTS FOR THE CONTRACTOR

Concrete Bridge Raised by Screw Jacks

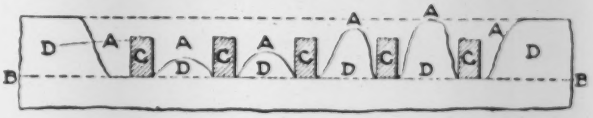
USING 60 screw jacks and ordinary house raising processes a concrete girder bridge weighing 88.6 tons and having a clear span of 36 ft. was recently raised to conform to the new grade of a street being paved at Davenport, Iowa. The bridge carried a 24-ft. paved roadway and two 4-ft. sidewalks and was raised 2 ft. at one



STREET BRIDGE RAISED BY SCREW JACKS

end and 2½ ft. at the other end, as indicated by the accompanying view. Including $40 premium on a bond required of the contractor, the cost was $440. It required two weeks to complete the operation.

When the bridge was constructed in 1913, the old abutments were cut out roughly, as indicated by the sketch, to provide seats for the girders. Afterwards the spaces *AA* were concreted in one pouring with the girders *CC*. In raising the bridge, cribbing was built up underneath at each end and on each cribbing 30 jacks were set to bear underneath the bridge platform. Under pressure from the jacks, the abutment concrete



FRONT ELEVATION OF ABUTMENT

was cracked with chisels along the line *BB*. The gap, after the bridge was raised, was packed with concrete. Nine days later sand-cement mortar was worked into the spaces left by the shrinkage of the concrete.

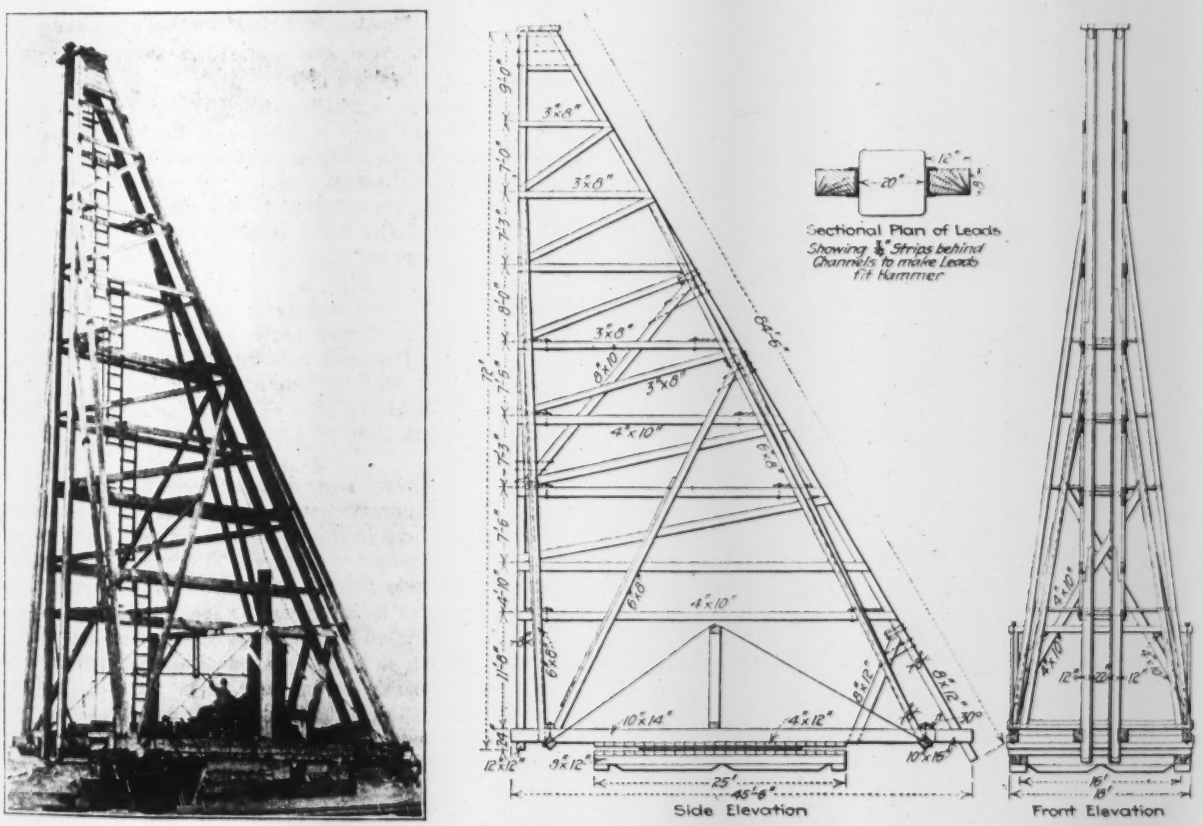
A professional house mover, H. Behrens, Davenport, Iowa, was the contractor for the raising operation, which was performed under the direction of City Engineer Roscoe K. Earle.

Piledriver Has Double Set of Leads

BY MARSHALL G. FINDLEY

Asssistant Designing Engineer, Board of Commissioners, Port of New Orleans, La.

THERE are about 2,000 batter piles in the walls of the lock now being built by the Board of Commissioners of the Port of New Orleans, for the new Inner



PILEDRIVER IN NEW ORLEANS HARBOR WORK HAS LEADS ON BOTH VERTICAL AND INCLINED SIDES

Harbor Navigation Canal. For these piles it was decided to build two special drivers, of the details and general appearance shown in the foregoing illustrations, the novel feature being the placing of leads on both the vertical and sloping sides of the drivers. Both vertical and inclined leads are extended out a short distance from the plane of the main frame members and are detailed to take steam hammers. Provision is made for a shift of the top sheaves depending upon which of the leads is being used. A 60-ft. pile can be handled in the vertical lead and one of 75-ft. in the other leads, which are at an angle of 30 deg. with the vertical.

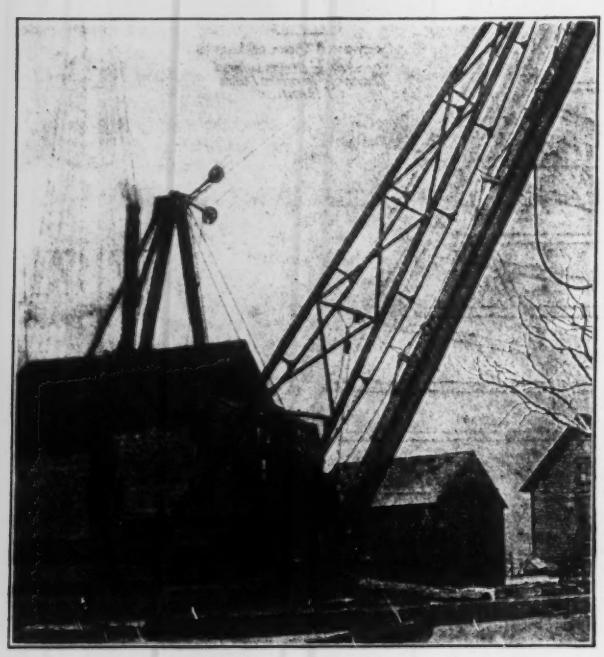
Driving Piles Through the Ice

By H. McL. Harding
Consulting Engineer, New York City

BETTER spacing and alignment of piles, both straight and batter, resulted from driving them from a machine mounted on ice at Milwaukee, Wis., the past winter, than has been possible with the usual floating driver. The operations were in connection with the municipal port development, and showed that, for some types of construction, winter work even in this latitude can be carried on quite as efficiently as summer work.

Along the inner shore of Jones Island, there is being built about 1,600 ft. of quay construction, which comprises the driving of rows of vertical and batter piles and attaching longitudinal and other timbers. The depth of the water near the shore, especially where the inner rows of vertical and batter piles are being driven, varies from 1 to 3 ft. This section is later to be filled with earth. In the summer, it would be necessary to dredge sufficiently deep to bring the scow supporting the piledriving machinery close to the shore or else to erect falsework along or near the bank. Either of these methods would have been expensive and have consumed much time in preparation.

For an average of some 70 ft. from the shore the ice



BATTER PILES BEING DRIVEN THROUGH ICE FOR MILWAUKEE HARBOR WORKS

was frozen some 2 ft. in thickness and when the water was 1 ft. in depth the earth under the ice was also frozen. After some consideration of the situation some 12 x 12-in. timbers were laid upon the ice and upon them

ROWS OF BATTER AND STRAIGHT PILES DRIVEN THROUGH ICE

were placed rollers which carried the framework of the piledrivers and the house containing the boilers, engines, cable drums, fuel, controls and accessories usually required for pile driving.

A small hole was started in the ice and by means of piledrivers and the house containing the boilers with a steam jet apparatus, consisting of a flexible armored hose with a 1-in. pipe bent at right angles, in about five or six minutes a hole in the ice was made and enlarged and the frozen earth was sufficiently softened so that the vertical and batter piles could be freely and easily driven. The alignment of not only the vertical but also of the batter piles driven at an angle of 30 deg. was so perfect that it was impossible to detect any variation.

After the several rows of piles were driven the longitudinal and other timbers were placed in position, the cuttings for these in the ice and earth also being carried on from the surface of the ice. The winches for operating grab buckets for other work similarly were moved to and fro upon timbers on the ice.

It was estimated from the progress that the number of piles driven in a day was double that which would have been possible in summer from the floating scow. The men, even those occupied in the outside work, could easily find time when the 60 to 65 ft. piles were being driven to become warm in the winch boiler room house. The men were more comfortable than when working in the cold water of the spring and fall. The lost days due to stormy weather were not more than during the other seasons.

NEWS OF THE WEEK

New York, April 29, 1920

Founder Boards Meet with Western Society

Many Views Expressed on Subject of Increasing the Engineer's Influence in Public Affairs

Governing boards of the founder societies and the membership of the Western Society of Engineers held a joint dinner and meeting April 19, in Chicago, where the representatives of the national bodies were having board meetings. Society unity was promoted and the occasion afforded to Middle West engineers a demonstration of the co-operation of the national organizations.

Arthur P. Davis, president of the American Society of Civil Engineers, in outlining the progressive ideas he had expressed at a meeting of the New York Section, March 31 (see *Engineering News-Record* April 15, p. 789), stated that the great changes which have come into men's minds in the past five years must be reflected in an expansion of the society to keep abreast of them.

In responding for Herbert Hoover, president of the American Institute of Mining and Metallurgical Engineers, who was unable to attend, Arthur Fletcher, director, laid stress on the engineer's fitness and duty to solve the present industrial problems.

F. J. Miller, president of the American Society of Mechanical Engineers, predicted the early construction of an engineering building in Chicago where might be housed some of the branch offices of the nationals. As to the public work of the proposed federation, he expressed the opinion that engineers should speak as expert witnesses only, not forgetting that the layman has as much right to his opinion as the engineer to his on matters of public policy; otherwise dissension will be created. On the question of publicity he outlined a plan whereby local societies should select one man to collaborate with the editors of the local press in translating what the engineer is doing or trying to do in the public interest. This man would learn through the editors what will interest the public and can give the editors accurate information on these subjects.

"How to obtain teamwork among engineers is the problem ahead of us," said Calvert Townley, president of the American Institute of Electrical Engineers. Unselfiish public service must be rendered and kept as the ideal of professional organization. To this kind of service the public will respond.

If the many societies can be made to understand that no one wants to take away any of their rights but to encour-

(*Continued on p.* 884)

E. J. Mehren to Investigate European Conditions

E. J. Mehren, editor of *Engineering News-Record* sailed for Europe on the "Adriatic," April 24. He will study conditions in the civil engineering field in England, France and Germany and will be abroad until the latter part of August.

Mr. Mehren has also been appointed special agent for the U. S. Bureau of Public Roads, in order to secure certain information while abroad for that organization.

Senate in Favor of Separate Construction Service

The final vote in the Senate on the Construction Service of the Army showed 33 Senators for a separate construction service and 18 opposed. An earlier announcement of this vote failed to take into consideration certain pairs among Senators. While there is a very determined portion of the House membership which is opposed to a separate construction service, the chances apparently are very much in favor of recession on the part of the House.

New York Port Treaty Rejected

Governor Edwards, of New Jersey, has vetoed the bill which had been passed by the Legislature committing New Jersey to the treaty between that State and New York in the control of New York harbor. The treaty authorizes the formation of a joint port body, composed of three representatives from each state, which would exercise full authority over the port. A similar bill which was before the New York Legislature never came to a vote before the Legislature adjourned on April 24. The New Jersey Legislature still has the opportunity to pass its bill over the Governor's veto. Meanwhile the New York-New Jersey Port and Harbor Development Commission is working on its comprehensive scheme for the development of the port and should render a report by July 1.

Call Issued for Organizing Conference of Engineers

Civil Engineers Not To Be Bound Without Letter Ballot—Delegate Representation Changed

To 111 national, state and regional engineering organizations the Joint Conference Committee of the national societies of civil, mechanical, electrical and mining engineers this week issued a call to participate in an Organizing Conference to be held at Washington, D. C., June 3 and 4 for the purpose of creating a "comprehensive organization" to secure united action of engineering and allied technical professions on matters of common interest to them.

Following the American Society of Civil Engineers' canvas of ballots on the Questionnaire and the defeat of Question 3, as reported in *Engineering News-Record* last week, the board of direction of the society considered at its recent meeting in Chicago the status of that organization with respect to participation in the Organizing Conference. Under date of April 19, telegrams were sent to R. L. Humphrey, Gardner S. Williams and George G. Anderson, the American Society of Civil Engineers' representatives on the Joint Conference Committee, informing them that the board of direction requested the society's representatives, pending further instructions, to refrain from participation in the issuance of the call for the conference at Washington.

Basis of Delegate Representation

The situation, so far as the American Society of Civil Engineers was concerned, was complicated by the defeat of Question 3 and by the fact that the board of direction desired a change in the basis of delegate representation at the Washington conference. As originally planned, national societies were to have one delegate for from 200 to 2,000 members, and an additional delegate for each 2,000, or major fraction thereof, while local and state bodies were to be represented by one delegate for from 100 to 1,000 and one delegate for each additional 1,000 members, or major fraction thereof. This plan of representation was changed just before the call was sent out to a uniform basis of one delegate for from 100 to 2,000 members for all organizations and additional delegates for each additional 2,000 members or major fraction thereof.

The board of direction of the civil engineers passed a resolution at its Chicago meeting which was substantially as follows: Without committing the society to the approval of any tentative draft of a constitution for the new organization, submitted by the Joint Conference Committee, the Am. Soc. C. E.

board instructs its representatives (1) to urge that the call to the Organizing Conference be limited to technical societies, and (2) to endeavor to secure a change in the call which would make representation of national societies the same as for local organizations. This change in representation has been made as above outlined.

The board also was specific in stating that the American Society of Civil Engineers was not to be bound by anything the conference might do, but that its delegates must submit, through the board to letter-ballot of the society, the acceptance or rejection of any organization decided upon at Washington.

To State Result of Questionnaire

The board also passed a resolution naming the president of the society as a member and chairman of the committee of delegates, specifying that, while the delegation should include members of the Joint Conference Committee, their number should be a minority of the total delegation. According to the board's resolution, the American Society of Civil Engineers' delegates will be instructed to state at the Washington conference the result of the vote on the Questionnaire by which the plan of organization suggested by the Joint Conference Committee has been negatived. It was the sense of the board, expressed in Chicago, that the delegates should present the plan outlined by the Alvord committee.

With regard to the American Society of Civil Engineers' wish that representation at the Washington conference be confined to "technical" societies, it was stated at the Joint Conference Committee's headquarters in New York this week that the American Association of Engineers had been invited to send delegates to the Washington meeting.

Object Defined

The call has taken the form of four mimeographed pages explaining the objects of the Organizing Conference, with enclosures consisting of the report of the Joint Conference Committee, a synopsis of the action taken on the committee's report by various national and local engineering organizations, the American Society of Civil Engineers' Questionnaire ballot and a credential blank. The object of the conference is stated as follows: "Co-operation of engineering and allied technical organizations to further the public welfare wherever technical knowledge and engineering training are involved, and to consider matters of common concern to these professions."

The Joint Conference Committee desires to receive the names of all delegates prior to May 15. The committee is also preparing a form of constitution and by-laws for the proposed comprehensive organization.

As yet the delegates for the American Society of Civil Engineers have not been announced. President A. P. Davis, however, will head the conference representatives of the civil engineers.

A. A. E. Passes 16,000 Mark

The membership of the American Association of Engineers on April 15 was 16,007.

Speakers Named for A. A. E. Convention at St. Louis

Among the speakers at the sixth annual convention of the American Association of Engineers to be held at the Planters Hotel in St. Louis on May 10 and 11 will be M. O. Leighton, chairman of the national service committee of Engineering Council, who will speak on "Getting Salaries for Public Service Engineers Into Budgets," Frances A. Kellor, vice-chairman of the Inter-Racial Council of New York and a recognized authority on immigration and racial problems, who will speak on "The Manpower Engineer—The Opportunity of Americanism" and Fred Lavis of the American International Corporation of New York, who will speak on "Opportunities for the Engineer."

The principal speakers at the banquet on May 11 will be Doctor F. H. Newell, president of the American Association of Engineers and head of the department of civil engineering at the University of Illinois, and L. K. Sherman, president of the United States Housing Corporation.

A feature of the convention will be group meetings for draftsmen, federal engineers, mining engineers, highway engineers, industrial engineers, chemical engineers, municipal engineers and railroad engineers. These meetings will be held on the evening of May 10. They will consider problems peculiar to each group and make a report to the general business session on the following day.

Founder Boards Meet

(*Continued from p.* 883)

age and strengthen them in their work, Mr. Townley believed that the organizations would join in a broad unselfish movement for the good of the state. "The war was called an engineers' war. Let us make the peace an engineers' peace," was his final appeal.

Dr. Theodore G. Soares, head of the department of theology, University of Chicago, indicated the important place the engineering professor had in life and the grave responsibilities resting on the engineer. Because of the sheer bigness of modern life, he pointed out, abler advice than ever before must be obtained. It is the acceptance of the expert that is going to make real democracy and votes must be weighed as well as counted. In a New England town meeting one man's vote might be as good as another on questions relating to the town pump, but in a city of 3,000,000 people the problem of obtaining pure water is vastly different and must be left to experts. Disagreeing with Mr. Miller, he held that the engineer must be less modest. He must be more than an expert witness. He must prescribe, order and see that his orders are carried out.

St. Lawrence Engineers Appointed

Announcement has been made that two engineers to take charge of the engineering details in connection with the investigation of the improvement of the St. Lawrence River have been appointed by Canada and the United States. The Canadian appointment is W. A. Bowden, chief engineer of the Department of Railways and Canals at Ottawa. The United States has appointed Lt. Col. W. P. Wooton, Corps of Engineers, U. S. A., who is stationed at Detroit. Engineering plans and estimates are to be submitted to the International Joint Commission not later than one year from now, and the Commission is requested to forward to the two governments its final report not later than three months thereafter.

Discuss Future Organization of Engineer Corps

As finally agreed upon by the Senate, the Army Reorganization bill provides 650 officers for the Corps of Engineers. Senator Ransdell of Louisiana took the stand that the Corps was not being treated equitably in the bill but his amendment to increase the number of officers still further was voted down. His amendment also provided for two Assistant Chiefs of Engineers with the rank of Brigadier General. Speaking in support of his amendment he reviewed the importance of the duties performed by the Engineer Corps. In that connection Senator Wadsworth, who was in charge of the bill, made the following statement:

"Under the terms of the bill the Engineer Corps are made combat troops, placed upon the same basis as the Infantry, the Cavalry, the Field Artillery, the Coast Artillery, the Signal Corps, and the Air Corps. Being made combat troops, an officer of the Engineers is eligible for a brigadier generalship of the line, just as an Infantry officer, a cavalryman, a field artilleryman, or a coast artilleryman. There is no limit to the number of officers from the Engineer Corps who may be promoted to the grade of brigadier general of the line.

"The incentive under the terms of the bill for officers to join the Engineer Corps and serve in it, in my humble judgment, is greater than at any former time; for, whether they could contend before that they were combat troops and their men eligible for brigadier generalships of the line and major generalships in the line, the matter was not entirely clear, and many members of the corps labored under the impression that when it came to the matter of promotion to the grade of brigadier general in the line, an Engineer officer was apt to be discriminated against. The bill places the Engineers upon exactly the same basis as the Infantry, Cavalry, and other combat branches, so the Engineers will have the same opportunity for promotion to the higher grades as every other combat branch."

Start Work on Big Rail and Deep-Water Terminal at New York

Dredging for the channel of the first pier unit of a new rail and deep-water terminal in New York harbor, in the Greenville section of Jersey City, has been started by the Lehigh Valley R.R. The new development will be known as the Claremont Terminal. The first unit on which construction has now been started will be a 3,000-ft. wharf at the foot of Chapel Ave., Jersey City, for which a 35-ft. channel is now being dredged to deep water, requiring the removal of 3,500,000 cu.yd. of material.

It is planned that the terminal ultimately shall consist of three piers each about 7,000 ft. long and 400 ft. wide, carrying a large trackage and facilities for handling heavy miscellaneous export and import freight as well as for handling coal and ore. The pier lengths will include slips extending about 3,000 ft. back of the established bulkhead line. Ultimately an aggregate dock space of some 6 miles in length will be provided and the entire terminal will cover about 550 acres of ground.

The wharf now under construction will provide facilities for unloading 2,500 tons of ore per hour and will include an open pier with gantry crane for handling miscellaneous freight and a two-story steel and concrete warehouse. A yard, with a capacity for about 500 cars, which will be partly carried on the pier, is to be built in connection with the present unit.

Various newspaper reports have stated that the New York Central R.R. is planning a big freight terminal along the west bank of the Hudson River, just north of Weehawken. Officials of the railroad company have, however, stated that the only plan in contemplation is the necessary extension of yard facilities to serve the new piers for the Cunard Steamship Co., construction of which at Weehawken is now being planned.

Engineers Do Manual Labor During Strike

The Michigan Central Railroad section of the American Association of Engineers recently adopted a resolution offering the services of each of its members to the management during the recent railroad strike. The Pennsylvania Railroad section postponed its annual convention in order that its members might render such extra service as they might be called upon to perform on account of the strike. Railroad members of the association all over the United States have been engaged in all sorts of extra duty, such as firing engines, throwing switches and running engines. One switching crew on the Chicago Burlington & Quincy, made up entirely of civil engineers, performed work consistently in from 50 to 60 per cent less time than was occupied by the regular crew in performing the same duties.

Cleveland Subway Bonds Defeated

Early reports from Cleveland indicate that the street-car subway bond issue for $15,000,000 was defeated by a two to one vote in the referendum of April 27. The main reason for the defeat, according to local observers, is the people's conviction that the proposed expenditure would not provide real rapid transit.

New Water Conduit for Seattle

A new conduct some 15 miles in length for the water-supply system of Seattle, Wash., is to be built and bids are desired for 66-in. riveted or 64-in. lock-bar steel pipe, according to information supplied *Engineering News-Record* by A. H. Dimock, city engineer. Alternative bids for 58-in. steel pipe will also be received. The conduit will extend from Volunteer Park reservoir, where it will connect temporarily with the existing pipe lines and eventually by means of a tunnel with the proposed reservoir.

Unusual Program for American Water Works Convention

A goodly number of papers on various water-works in Canada, together with synopses of the main papers listed, are features of the tentative program for the fortieth annual convention of the American Water Works Association to be held at the Windsor Hotel, Montreal, Que., June 21-24.

The half-dozen papers dealing with Canadian water-works include one on "The New Water Supply of Winnipeg," by James H. Fuertes and William G. Chase. Among the other papers are: "Difficulties in Building the Louisville Pumping Station," by James B. Wilson; "Cost-Plus Contracts in Water-Works Construction," by George W. Fuller; and "The Trend of Prices," by Leonard Metcalf, the latter being a continuation of an earlier paper by Mr. Metcalf.

Superintendents' Day will be Thursday, June 24. All members having experiences in the selection, installation, reading and maintenance of water meters are requested to communicate at once with the editor of the *Journal* of the Association, John M. Goodell, Upper Montclair, N. J., or at least to come to the convention prepared to state their experiences. Water waste and legitimate use will also be discussed on Superintendents' Day. On the same day there will be a separate meeting of the Chemical and Bacteriological Section of the association, at which Col. George A. Johnson will introduce the subject of the quality of water.

On the afternoon and evening of June 23 entertainment will be provided by the Water Works Manufacturers' Association. An afternoon trip through the rapids of the St. Lawrence River has been planned, while in the evening there will be a smoker for men and a theater or card party for the ladies.

Four Bids Received on Hetch Hetchy Tunnels

Four bids, the lowest totaling seven and a quarter million dollars, were received by the City of San Francisco, April 21, for the construction of 18.3 miles of concrete-lined tunnels for the Hetch Hetchy water supply project. The net height and width of the tunnel section is 10 ft. 3 in. The figures submitted in the bids were as follows:

Construction Company of North America, $7,292,900. Also $82 per foot of tunnel.

R. C. Storrie, $8,798,000. Also $96 per foot of tunnel.

Utah Construction Company, $150 per foot of tunnel.

Healy-Tibbits Company, $178 per foot of tunnel.

By the terms of the information given to bidders proposals could be "submitted on the entire length, 18.3 miles, or the work may be divided into two sections 4.5 and 13.8 miles in length respectively." The foregoing figures are for the entire length of tunnels, and include the cost of concrete lining.

City Engineer O'Shaughnessy expressed satisfaction on learning the figures submitted by the Construction Company of North America, which are slightly less than those of the city engineer's estimate and more than one and one-half million dollars lower than the next highest bid.

The president of the Construction Company of North America is Charles Tinkler, who was formerly manager for MacArthur Brothers on the Hetch Hetchy tunnel work done by that firm.

Detroit Chapter A. A. E. Wants Law Against Strikes

Actuated by the serious conditions resulting from the railway yardmen's strike the Detroit chapter of the American Association of Engineers has defined its attitude toward the causes and has offered a remedy for their removal. The remedy would consist of state and federal laws to establish "the public's absolute right to continuous service from public utilities by making it a felony for any owner, employee or others to commit any voluntary act calculated or likely to cause serious impairment or discontinuance of necessary services to the public."

The chapter also asks for "state and federal industrial tribunals with authority to take charge of, on their own initiative or on an appeal, and decide any industrial controversy that is likely to jeopardize the public welfare, or of any other industrial controversy on request of either party, to impose penalties and compel compliance with its decisions."

Throop College Changes Name

By the unanimous vote of its Board of Trustees, Feb. 10, Throop College of Technology has become the California Institute of Technology.

Call for Engineers on Sewage Problem at Oklahoma City

Consulting engineers versed in sewage disposal are invited to submit statements of their training and qualifications to H. E. Musson, chairman of the Committee on Engineering of the Sewage Board of Oklahoma City. The board named was appointed in accordance with a resolution of the city commissioners of Oklahoma City asking that the Lions', the Rotary, and the Kiwanis Clubs, the Chamber of Commerce, the Building Trades Council, and the American Association of Engineers each appoint one of its members to act on a sewage board to consist of the representatives named, together with the city engineer, city physician, and sanitary engineer of the State Board of Health. The board named is "to make an investigation of the sewage problems confronting Oklahoma City and advise with the city commissioners with reference to the same." The circular that has been issued inviting consulting engineers to communicate with the Committee on Engineering states that Oklahoma City has approximately 4,000,000 gal. of untreated wastes from packing plants and 7,000,000 gal. of domestic sewage, together with sewage from other industries, such as oil refineries, to be treated every 24 hours.

Kansas Highway Officials Study Road Construction Problems

As an outgrowth of a meeting recently held in the offices of the Kansas State Highway Commission, attended by approximately 70 contractors and material men of the state, a committee has been appointed to investigate the supply of materials and co-operate with the Highway Commission, keeping it informed as to the status of materials, so that contracts will not be let in excess of the amount of materials available. During the meeting it was discovered that the road building program was a great deal larger than the material supply and the transportation would allow to be constructed. It was the general opinion, however, that Kansas would proceed with highway work as rapidly as conditions would permit, but it was not considered advisable to force the road building program. Lack of transportation appears to be the chief difficulty to overcome, and M. W. Watson, state highway engineer, speaking in that connection, asserted that "the general public has been educated to designate open top equipment as coal cars and as a result of this general opinion influences have continually been brought to bear on the government officials in charge of the distribution of cars to give preference to coal shipments even at times when the supply of coal was adequate throughout the country."

Kansas has under construction at the present time approximately 200 miles of hard surface roads which, in the opinion of Mr. Watson, will utilize all available materials and labor.

New York License Bill Passed

Both houses of the New York State legislature passed the engineers' license bill recently introduced by representatives of a group of technical societies. The bill awaits the governor's signature. Originally separate bills were presented to the legislature by the New York chapter of the American Association of Engineers and by the Albany Society of Civil Engineers. A joint committee consolidated the two into a compromise bill, which was passed without substantial opposition.

Rail Administration Announces Barge Line Expenses

Obligations totaling $15,265,550 were incurred by the United States Railroad Administration for inland waterway barge line equipment, according to figures made public in connection with a request for the deficiency appropriation. The sum of $11,786,544 has already been advanced on the obligations contracted, leaving a balance required of $3,479,011.

Allowing for omissions of general items, an expenditure of $4,591,210 was made for the New York State Barge Canal; $7,697,300 for the Mississippi River line, and $2,601,096 for the Warrior River line. From Sept. 30, 1918, to Dec. 31, 1919, the New York State Barge Canal tonnage was 122,379 tons eastbound and 43,879 tons westbound. The Mississippi Barge line tonnage was 90,438 tons southbound, and 37,709 tons northbound; and on the Warrior River line 152,037 tons southbound, and only 189 tons northbound.

Civil Service Examinations

New York State

For New York State civil service examinations listed below, apply to the State Civil Service Commission, Albany, N. Y. Applications must be filed not later than May 5.

Assistant sanitary engineer, State Department of Health, $2,600 to $3,000 per year.

Engineering assistant (civil) State Engineer and Highway Departments, $1,080 to $1,560 per year.

Engineering draftsman, grade 8, $1,501 to $1,800 per year.

Junior assistant engineer (civil) grade 2, State Engineer and Highway Departments, $1,980 to $2,280 per year.

Junior assistant engineer (civil) grade 1, State Engineer and Highway Departments, $1,620 to $1,860 per year.

Canada

For Canadian civil service examinations listed below, apply to the Employment Service of Canada or the Secretary of the Civil Service Commission, Ottawa. Applications must be filed not later than May 6.

Hydraulic engineer, $2,700 to $3,180 per year.

Assistant hydraulic engineer, $2,100 to $2,580 per year.

Junior engineer, $1,680 to $2,040 per year.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston; May 4-6; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Aug. 30-Sept. 3.

The San Francisco Association of Members, Am. Soc. C. E., held its regular bimonthly meeting April 13. By way of experiment at the meeting, the association had as dinner guests five senior civil engineering students from Stanford University and five from the University of California. The idea was to give these men an opportunity to get acquainted with the purposes of the local section and the parent society. It is possible that the plan may be continued throughout the year, having a different group of students at each meeting. The paper of the evening was entitled "Timber Preservation, Costs, Methods and Results," by Edmund M. Blake, production engineer for Charles R. McCormick & Co.

The Engineers' Society of St. Paul, Minn., held its regular meeting Monday evening, April 12. A committee report on municipal salaries was presented recommending that the society adopt the grading and schedule of salaries as reported by the committee of Engineering Council on classification and compensation of engineers; the recommendation was adopted. St. Paul has at present a salary limit of $5,000 for appointive officers; and through the efforts of the society the city council has passed a resolution recommending to the charter commission that such restriction be removed. This matter and the placing of such officers under civil service will be followed up before the charter commission by a special committee of representative engineers.

The Engineering Society of Western Massachusetts held its regular March meeting, which had been postponed on account of weather conditions, on April 6, at the offices and factory of the Fisk Rubber Co., Chicopee Falls, Mass. The members of the society, as the guests of the Fisk Co., were taken on an inspection trip through the factory, which was followed by supper and a talk in the evening on the manufacture of tires from the raw product to the finished product.

John Bogart Dead

John Bogart, former secretary, as well as treasurer and director of the American Society of Engineers, and at one time state engineer of New York, consulting engineer to the New York Board of Health and chief engineer of the New York Rapid Transit Commission, died at his home in New York City, April 23, aged 84 years. At the time he was taken ill, eleven days before his death, he had been actively practising, having been the senior member of the consulting firm of Bogart & Pohl.

Although a general practitioner, as were practically all of the pioneers of engineering, Mr. Bogart was perhaps best known for his work in connection with public park planning and improvement in New York City and elsewhere, and in his later years for hydro-electric development at points along the St. Lawrence River, in the southern and western states and in British Columbia. He also was engaged on development work in various Venezuelan harbors.

Mr. Bogart was born in Albany, N. Y., Feb. 8, 1836. He was educated at Albany Academy and Rutgers College, from which institution he was graduated with a B.A. degree in 1853, taking a master's degree three years later. He began the study of law, but, because of his health, sought employment in the engineering corps of the New York Central R.R., a few months after his graduation. Thereafter he followed engineering work exclusively, though he continued his studies of law for several years. From the New York Central Mr. Bogart went as an assistant in the engineer department of the canals of the State of New York. From there he aided in the construction of roads, bridges, drainage and landscape developments of Central Park, New York City.

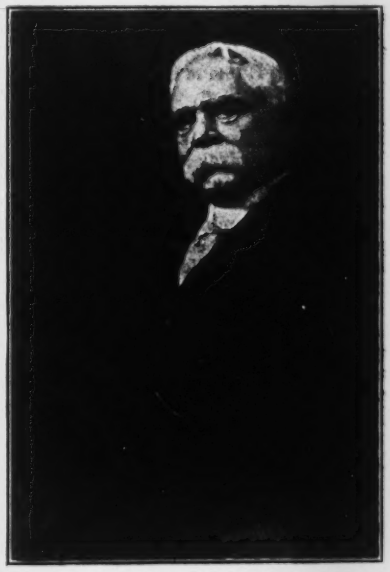
Served in Civil War

During the Civil War Mr. Bogart was engineer of fortifications on Fort Monroe and other points, serving under the direction of officers of the Corps of Engineers. He resigned that office in 1866 and returned to New York City to engage on public park work. He then served as chief engineer of the Park Commission of Brooklyn, having much to do with the development of Prospect Park, as chief engineer, Department of Parks, New York; and he designed parks at Albany, New Orleans, the state grounds at Nashville, the West Side parks at Chicago, and the park system of Essex County, N. J. From 1888 to 1891, inclusive, he was state engineer of New York and from 1892 to 1900 served as consulting engineer to the state health board.

As consultant to the Niagara Falls Power Co., Mr. Bogart was among the first engineers of this country to assist in developing power for transmission for commercial use. Other hydro-electric work was done by him as consulting engineer for the St. Lawrence Power Co., Atlanta Water and Electric Power Co., the Cascade, British Columbia Power Co., the Knoxville Power Co., the Niagara, Lockport and Ontario Co., and the Chattanooga and Tennessee River Power Co. Railroad work did not escape his attention and he served as consultant to several roads, including the New York Central R.R.

Secretary, Am. Soc. C. E., 1878-1890

Mr. Bogart served the American Society of Civil Engineers as secretary from 1878 to 1890. He also served as director from 1873 to 1875 and as treasurer from 1875 to 1877. After leaving the secretaryship he was again made treasurer, holding that office for four years.



JOHN BOGART

Because of his interest in inland waterways Mr. Bogart represented the United States at the International Congress of Navigation at Düsseldorf, Germany, in 1902; at Milan, Italy, in 1905; and at St. Petersburg, in 1908. He was a member of the Permanent Board of International Navigation Congresses and the only civilian member of the U. S. Government board on the Lakes to the Gulf Waterway.

Mr. Bogart was formerly a lieutenant-colonel of the New York State National Guard and was a member of the Institution of Civil Engineers of Great Britain. He had also served as member of the Municipal Art Commission of New York, and as vice-president of the Institute of Inventors, London.

Import Duty to Aid Profession

The Council of the Royal Architectural Institute of Canada has petitioned the Customs Board at Ottawa for a revision of the basis of appraisal on imported architectural and engineering plans with the object of increasing the duties, and so foster the development of architecture and engineering in Canada.

PERSONAL NOTES

LEWIS E. KNERR, former captain of Engineers, U. S. A., has resigned his position in the Tacoma (Wash.) city engineer's office to become constructing engineer of the Seattle (Wash.) Hemlock Mills, Ltd.

CLOYD M. CHAPMAN, formerly with Westinghouse, Church, Kerr & Co., Inc., has opened an office at 171 Madison Ave., New York City, for the practice of consulting engineering.

A. A. MCGRATH and W. M. SCHENKELBERGER have gone into partnership under the firm name of McGrath & Schenkelberger, for the practice of civil engineering, with offices in the American Trust Building, Cleveland.

A. G. GOULD, for the past 14 years vice-president and treasurer of the Gould Construction Co., Davenport, Iowa, has severed his connection with that company to become vice-president and chief engineer of the H. Denburger Contracting Co., Bethlehem, Pa.

W. R. ELLIOTT has resigned as general manager and chief engineer of the Salt River Valley Water Users' Association (Ariz.) to go into private practice.

O. C. STRAIGHT and FRED B. MCCLURE, civil and mining engineers, have opened offices in Fairmont, W. Va., as successors to the Fairmont Engineering Co.

P. H. NORCROSS has been selected by the board of water commissioners of Atlanta, Ga., to make a special survey of the water system of that city in line with an extensive program recently adopted for the improvement of the Atlanta water supply.

FRED O. EICHELBERGER, city engineer of Dayton, Ohio, has been appointed director of public service, succeeding H. P. Martin, who has resigned to become manager of the Des Moines district for the Delco-Light Co. The position of city engineer is left unfilled by the new appointment of Mr. Eichelberger.

HAL M. SCOTT, former captain of Infantry, 32nd Division, U. S. A., has been elected chief engineer, and JOHN P. BONNER, former captain of Trench Mortars, 2nd Division, U. S. A., has been elected resident engineer, of the Greenbrier & Eastern R.R. Co., with headquarters at McClungs, Greenbrier County, W. Va. Construction has just been begun on this railroad, which will connect with the Sewell Valley R.R., at Rainelle, W. Va., and will be about 12 miles in length.

ROBERT H. FORD has been promoted from principal assistant engineer to assistant chief engineer of the Chicago, Rock Island & Pacific Ry.

WALTER L. DECKER, formerly construction engineer of the American Ship Building Co., at Cleveland, is now associated with the Austin Co., of that city, as district superintendent.

H. J. HARDER, city engineer of Paterson, N. J., has been appointed a member of the New Jersey State Department of Health.

C. A. HOWLAND, assistant engineer, New York State Department of Health, has resigned to take a position with Johnson & Benham, consulting engineers, New York and Kansas City. He will be located at Kansas City.

H. E. BILGER, formerly in the Illinois State Highway Department, later senior highway engineer, U. S. Office of Public Roads, and more recently consulting engineer, Monmouth (Ill.) Stone Co., has become general manager of the Highway Culvert Form Co., Peoria, Ill.

LOUIS T. C. LORING, for 20 years with the Massachusetts State Highway Commission, 17 of which was spent as assistant engineer in Division 1, is now associated with the Portland Cement Manufacturers' Association at Boston.

MAJOR RAY W. BERDEAU, formerly with the U. S. Engineers, on New York harbor improvements, has left for Hong Kong, China, in the employ of the Vacuum Oil Co.

HENRY WELLES DURHAM, formerly Major, Engineers, with the American Expeditionary Forces, has received from the French Government the *Mérite Agricole*, a decoration conferred in recognition of his work on road construction and maintenance during his service abroad with the Division of Construction and Forestry.

L. FRED PATSTONE, recently Major, 217th Engineers, U. S. Army, has resigned as city engineer of Manila, P. I., to accept the managership of the China Commercial Development Co., with offices at 34 Nanking Road, Shanghai.

ANTON ANDERSON has been appointed engineer of maintenance-of-way, Chicago, Indianapolis & Louisville Ry., with office at Lafayette, Ind.

OBITUARY

ALVIN ETHEREDGE, civil engineer, died at Columbia, S. C., March 22, at 58 years of age. He was born in what is now the town of Saluda, S. C., and received his education at Furman University and the Worcester Polytechnic Institute. Mr. Etheredge was engineer in charge of the surveys of proposed railway routes from Augusta, Ga., to Knoxville, Tenn., and from Augusta to Newberry, S. C. Neither of these projects materialized, but the grading of the Augusta-Newberry route was practically completed. He was also in charge of the construction of the Carolina Light & Power Co., at Graniteville, S. C., the second long-distance transmission power plant built in the South.

J. W. GRAFF, civil engineer of Seattle, Wash., died recently. He was widely known throughout the Northwest, having had charge of the location work on the Northern Pacific and Great Northern railroads to the Pacific Coast. In the early 80's he had charge of the location of the Esquimalt & Nanaimo Ry. on Vancouver Island, and in 1905 located the Chicago, Milwaukee & St. Paul Ry. to the Pacific Coast. Born in Fredriskhald, Norway, he received his education in that country and Germany, and came to America in 1882.

A. K. GAULT, division engineer of the Chicago & Northwestern Ry., at South Norfolk, Neb., died recently.

WARREN CUMMINGS KNOWLTON died at Denver, Col., Feb. 4, aged 41. He was a graduate in civil engineering of the University of Minnesota. He began his railroad work as rodman, instrument man and locating engineer on the Great Northern R.R. in Idaho and British Columbia, in 1900. Subsequently, he was in charge of field surveys and construction work on the Chicago Great Western R.R., and the New York Central & Hudson River R.R., division engineer on the Virginian Ry., and in charge of the engineering and construction of the Pacific Ry. between the Atlantic and Pacific Oceans in Costa Rica, for W. H. Knowlton, commissioner and contractor for that work for the Costa Rican Government. For the past nine years Mr. Knowlton had been engaged in grain and stock raising in South Dakota and Colorado.

JAMES HENRY DECKER, a former resident of Watertown, N. Y., died at Lafayette, Ind., March 29, at 37 years of age. He graduated from Purdue University in 1905, and immediately afterward joined the engineering staff of the Panama Canal Commission. During his seven years' service on the canal, Mr. Decker designed several of the large bridges crossing the main spillway. During the war he was associated with the A. G. McKee Engineering Co., Cleveland, and engaged in the design of blast furnaces for the U. S. Government.

ALBERT E. WOOLF, American pioneer in attempts to treat water and sewage electrolytically, died in New York City, April 19, at the age of 74 years. In the early nineties he applied electrolytically produced hypochlorite under the trade name "electrozone" directly to sewage, water, a polluted dock slip, and to a fill of mixed garbage and refuse, all in or pertaining to New York City. He also built an "electrozone" plant to treat the sewage of Danbury, Conn., which figured in a protracted lawsuit and was soon abandoned. "Electrozone" was also used in Havana Harbor during the American occupation of Cuba. At the time of his death Mr. Woolf was head of the Woolf Laboratories, New York City.

BUSINESS NOTES

WILLIAM N. KEISER, formerly with the Hydraulic Steelcraft Co., Cleveland, has been appointed manager of the general construction equipment department of the Lakewood Engineering Co., of that city.

HAROLD S. HUTTON, formerly sanitary engineer with the U. S. Public Health Service, has been appointed district sales representative of Wallace & Tiernan Co., Inc., with headquarters in the Commonwealth Building, Pittsburgh. He succeeds P. O. Collins, who is on an indefinite leave of absence on account of illness.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, formerly conducted as a co-partnership by Jos. S. Lovering Wharton, Wilfiam S. Hallowell and John C. Jones, has been incorporated as the H S B W—Cochrane Corporation, with the following officers: President, Mr. Wharton; vice-president and general manager, Mr. Jones; secretary and treasurer, Mr. Hallowell; general sales manager, Horace E. Sibson; general works manager, Axel B. Wallem.

THE KENNEDY VALVE MANUFACTURING CO. announces the appointment of C. H. Kennedy, formerly New York district manager, as general sales manager, with headquarters at the plant, Elmira, N. Y. J. S. Hanlon, formerly Boston representative, takes Mr. Kennedy's place in New York. George W. Waters, formerly in the sales department, New York office, has been made Boston representative. F. N. Decker, formerly at Elmira, has been placed in charge of a new sales office opened at 208 Mutual Building, Kansas City.

THE LINK BELT CO., Chicago, is expanding its works in Chicago, Indianapolis, Philadelphia, Seattle and Toronto. New manufacturing facilities have been added to the several plants and the personnel of both the factories and sales offices has been increased. The company announces its purchase of the Fairmount foundry, at Philadelphia. A new administration building is also under construction at the Philadelphia plant, a similar building is to be erected at Chicago and a new warehouse is under construction at Seattle. A. C. Johnson, formerly chief engineer of the Chicago works, has been elected a vice-president of the company and resident general manager at Chicago. He succeeds Prentiss L. Coonley, who recently resigned to become president of the Isko Manufacturing Co.

THE READING (Pa.) IRON CO. has purchased two of the plants of the Susquehanna Iron Co. at Columbia, Pa., known as the Susquehanna mill and Columbia mill.